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ESSENTIALS OF SURGERY

BY

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ESSENTIALS OF SURGERY

A TEXTBOOK OF SURGERY

FOR STUDENT AND GRADUATE NURSES AND FOR
THOSE INTERESTED IN THE CARE OF THE SICK

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49 ILLUSTRATIONS

SECOND EDITION REVISED
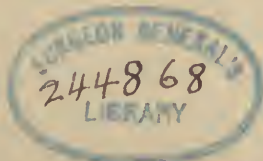
PREFACE

THESE notes are prepared for the use of senior nurses in connection with a course on "The Principles of Surgery," in the belief that the nurse can more intelligently assist in the care of her patient if she has a reasonable conception of the conditions present and of the indications to be met in treatment. An elementary understanding of anatomy, physiology, and bacteriology, as usually presented to nurses, is assumed. No attempt is made to cover these subjects, except in a few instances to emphasize certain relations to surgical conditions.

The course covers the general principles of surgical diseases and the pathological changes which result. Also, under separate headings, the more important surgical lesions involving special regions of the body, are considered. The matter is presented simply, and only general statements are made concerning:

1. Etiology, causal factors.

2. Pathology, local tissue changes produced, and general effects.

3. Natural course of the disease and spontaneous attempts to control the condition, also factors influencing the prognosis.

4. Indications for treatment, and the general principles which are to be considered. No attempt is made to discuss technical nursing methods, except special indications for their use.

I wish to express my appreciation to the Superintendent and to the Nursing Staff of St. Luke's Hospital Duluth, Minn., for co-operation in development of these notes.

To the publishers, J. B. Lippincott Company, I also wish to extend my thanks for their earnest coöperation in developing my drawings and ideas for the illustrations.

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PREFACE TO SECOND EDITION

In preparing manuscript to the second edition of Essentials of Surgery the same principles, which made the First Edition an unique text for nurses, have been followed. Descriptions of technique have been entirely omitted, since there are several excellent books on this subject. Numerous additions have been inserted to bring the information up to date. Since operative gynecology is commonly done by general surgeons, and in many institutions is considered as a branch of general surgery, a new chapter has been added, in which the surgical gynecological lesions are described in the same general manner as are those of other organs of the body.

Again the author takes pleasure in expressing his thanks to the J. B. Lippincott Company for their helpful coöperation in making possible the success of this book.

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ESSENTIALS OF SURGERY FOR NURSES

CHAPTER I

BACTERIA

KNOWLEDGE of the fundamental principles of bacteriology is necessary as an introduction to surgery for the following reasons:

1. Bacteria cause an important group of surgical lesions.

2. Bacteria also cause serious complications following surgical operations.

3. Aseptic technic, as used in the operating or dressing room, aims to prevent absolutely the contamination, by bacteria, of the wound, or anything which comes into direct or indirect contact with the operative field.

We must therefore call attention to some of the more significant relations of bacteria and micro-organisms to surgery.

CLASSIFICATIONS

Countless groups of bacteria are distinguished on the basis of shape, motility, reaction to special staining methods, and the character of growth on certain laboratory "media" (culture material). Diagnosis of the specific bacteria causing a given lesion may be determined by laboratory studies of the pus, secretions, or circulating blood, by one of the following methods:

(*a*) **Smears** of the material are made on glass slides and, after being killed or fixed on the slide by heat, are stained and studied under the microscope.

(*b*) **Cultures** are made by implanting a minute amount of the septic material or circulating blood on special laboratory media. The characteristic method of growth may thus be determined and the prevailing organisms are classified.

1

PATHOGENIC MICRO-ORGANISMS, *i.e.*, those which are able to invade the human body and give rise to pathologic changes, are the only ones of special interest in this connection.

The NON-PATHOGENIC BACTERIA, of which there are a great variety, are of only secondary importance, since they do not cause disease in the body.

AËROBIC AND ANAËROBIC ORGANISMS: This classification is made on the basis of the relation of certain bacteria to oxygen.

(1) *Aërobic* bacteria, comprising the majority of the pathogenic group, require oxygen to maintain life. When deprived of this gas, or air, such bacteria are destroyed or die.

(2) *Anaërobic* bacteria, on the contrary, thrive best in the absence of free oxygen, and are killed in its presence. This characteristic determines the habitat and distribution of certain organisms and accounts for the fact that they usually cause infection in "punctured wounds," *i.e.*, where they are remote from the air and free oxygen. It also indicates the methods of treatment of such infected wounds: free incision and exposure of the area. The tetanus and "gas" bacilli (see page 35) are important members of this group.

VARIATIONS IN INDIVIDUAL SPECIES OF BACTERIA

Resistance to unfavorable environment, including; lack of oxygen, lack of moisture, heat, certain chemical agents (germicides, substances which tend to prevent the growth of micro-organisms or to destroy them), varies greatly.

Spores result from changes assumed by certain types of bacteria when exposed to unfavorable conditions, and they are thereby rendered more resistant to destructive agents. They are inactive in this state, survive ordinary germicidal agents, but later multiply and become active when brought into a normal environment. The varieties of bacteria which take on spore form demand special methods of sterilization or fumigation; for example, repeated or prolonged exposure to unusually high temperature, steam under pressure, or strong germicidal agents.

Virulence.—This refers to the activity with which a given type of pathogenic organism attacks the individual who is invaded. A particular specific bacteria which, under certain circumstances, is relatively inactive, *i.e.*, of low virulence, will,

under other conditions, become highly virulent and cause most serious infection. Example: A mild tonsillitis in one individual will give a pure culture of streptococcus, while another person suffering from a much more severe form, with marked toxæmia, may show the same type of organisms on culture. This variation is controlled by many factors which are not clearly understood, but it determines to a great extent the effects of the invasion of the body by any given type of bacteria.

DISTRIBUTION

Pathogenic bacteria of one type or another are found almost universally in nature and are assumed to be present on any object or surface which has not been rendered sterile by proper methods, and continuously protected from further contamination. While bacteria of some type are found in all surroundings, certain varieties are more prevalent in special localities and materials. For example:

1. In manure, street-dirt, about barns and in fertilized soil are found some of the following: *B. tetanus, B. coli, B. aërogenes capsulatus,* gas bacillus.

2. Sewage or material contaminated with human excreta is likely to contain *B. coli,* typhoid bacilli, and various groups of streptococci.

3. Sputum and secretions from the nose and mouth may contain tubercle bacilli, diphtheria bacilli, pneumococci, meningococci or streptococci.

4. Urethral or vaginal discharges are always to be regarded as possibly containing active gonococci.

5. Hospital operating or dressing rooms where infected wounds are treated are likely to show *B. coli* and various types of streptococci or staphylococci.

STERILIZATION

Sterilization means the destruction of all bacterial life on any object or in any material, which is then spoken of as being *sterile* or *aseptic.* Various methods of sterilization are adapted to special materials or surfaces of the body. It is not possible to discuss the different technics in detail, as each operating room has developed its special routine. Only experience in the actual work under an exacting superintendent can familiar-

ize the student with principles and methods. (See also such books as "The Operating Room," by Fowler, and "Aseptic Technique," by Robb.)

An ANTISEPTIC or GERMICIDE is an agent which destroys bacteria, including the following: *A*, direct heat; *B*, steam; *C*, chemicals.

A. Heat.—1. The flame destroys most materials, injures many instruments, and is only used in emergency for solid metal instruments or glass slides.

2. Baking is destructive to most materials and is not a reliable method.

B. Boiling and Live Steam under Pressure.—1. Boiling for from 10 to 20 minutes is used for water, solutions, metal instruments (except knives, which lose their temper and are usually sterilized in carbolic acid and alcohol), glassware and similar materials.

2. Live steam under pressure in an autoclave is necessary to insure penetration of gauze dressings, and to give complete sterilization. The process is repeated on two or more successive days to destroy spores which may be present.

C. Chemicals in solutions of varying strength are used under conditions where neither of the above methods is feasible. Some of these are: Mercury preparations, bichloride, biniodide, carbolic acid or its derivatives—lysol or liquor cresolis comp., tincture iodine, boracic acid, and others less commonly used.

Aseptic technic refers to a method of procedure in the operating or dressing room whereby everything that comes directly or indirectly into contact with the wound and tissues is sterile or aseptic. To be successful, there must be no possible contamination of the operative field or of anything which comes in contact with it, by an object which has not been rendered and kept sterile. Such methods are used at all operations and for dressing any wound. It is impossible and useless to describe these in detail and they can only be acquired by prolonged experience in a well-regulated operating room. Work in a bacteriological laboratory will emphasize the necessity for an absolutely unbroken technic to prevent contamination in any aseptic procedure. (See experiments at the end of the chapter.)

Antiseptic technic involves the use of germicidal chemical solutions to prevent the growth of any pathogenic organisms

which may be present. It is used in the case of wounds which
are already infected, or under conditions where dependable
asepsis is not possible.

THE BODY IN RELATION TO BACTERIA

A. All of the exposed surfaces of the body, together with the
membranes which line the various cavities opening upon the
surface, are subject to contamination with bacteria.

B. The surfaces are protected against invasion of pathogenic
bacteria by the following factors:

1. The structure of each surface is adapted in some degree
to the extent of its exposure to bacterial contamination. The
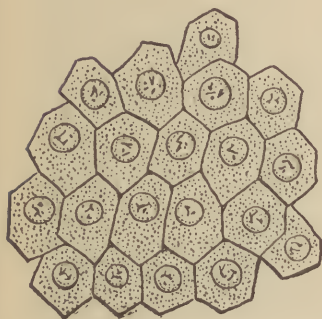
FIG. 1.   FIG. 2.
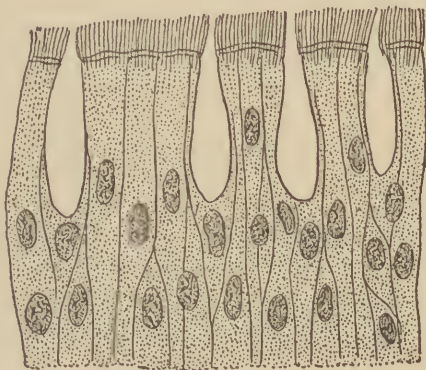
FIG. 1.—Simple squamous epithelium.
FIG. 2.—Stratified ciliated columnar epithelium.

surface, being covered by a complete intact layer of epithelium
resting on a basement membrane, is impervious to bacteria
which are normally present. In particular regions:

The skin, mouth, and orifices of the various cavities
which are most exposed, are covered by "squamous stratified
epithelium," which is especially protective as compared to the
single-layered "columnar epithelium" of more remote regions
(Figs. 1 and 2).

2. (*a*) The mechanical effects of the secretions and excretions
of various ducts and cavities tend to carry invading bacteria
to the surface of the body.

(*b*) The mechanical effect of special "ciliated epithelium" (example, the trachea and bronchi) tends to carry all foreign matter to the throat.

(*c*) The chemical and bactericidal action of certain secretions (hydrochloric acid of the gastric juice and the normal vaginal secretion) is sufficient to destroy ordinary bacterial invaders.

(*d*) The activity of certain non-pathogenic organisms in the intestinal tract tends to prevent the accumulation and growth of pathogenic bacteria which may be present.

C. All such exposed surfaces must be regarded as septic and infected. Effective sterilization is impossible without destroying tissues or lowering their resistance to bacterial invasion. While the actual surface can be rendered free of micro-organisms by mechanical cleansing and the use of germicidal solutions, bacteria penetrate to the deeper epithelial layers, or into the sweat, sebaceous or mucous glands, and escape. This fact is important from two standpoints:

1. The preparation of the surgeon's hands for aseptic operations. It is assumed that careful cleansing and the use of a chemical germicide according to some accepted method is sufficient to remove and destroy all pathogenic germs on the skin, and that those in the deeper layers are not likely to reach the surface and contaminate the wound, sterile instruments and dressings. However, the surgeon rarely depends entirely upon such methods, but wears sterile rubber gloves for all operations and often for dressings. This is for one of two purposes: (*a*) To prevent the contamination of aseptic wounds or tissues in non-infected cases; (*b*) to protect his own hands in treating septic or infected wounds and to avoid any secondary invasion by other pathogenic organisms. In dressing wounds without gloves, sterile instruments are used extensively, and all contact with the hands is avoided.

2. Contaminated surfaces as a source of infection of penetrating wounds. The skin: Ordinary surgical preparation removes or destroys practically all pathogenic bacteria which may be present. The local blood-supply is rich enough to overcome most of the accidental invading organisms. At times bacteria from the deep layers which have escaped sterilization invade a wound through the surface and cause local infection. The so-called "stitch abscess" is formed by such organisms,

causing infection which extends along sutures penetrating the skin. Other epithelial surfaces—mouth, intestinal tract, and vagina—are constantly exposed to bacterial contamination and are considered as infected or septic. Local sterilization of these regions is even less successful than is the case with the skin, and wounds soiled with the contents of such cavities must always be regarded as infected.

D. Bacteria which are present on such epithelial surfaces or in the various epithelial lined cavities are practically outside of the body, and are harmless till they have broken through the epithelium and have actually invaded tissue cells. In order for harm to occur, we presuppose a definite "portal of entry," *i.e.*, a destruction of the intact protective epithelium, or an opening (wound) through which pathogenic bacteria and toxins reach the tissue cells and body fluids, where they may be taken up by the circulation.

A portal of entry may occur as the result of one of the following conditions:

1. Wounds, intentional operative wounds or those which are the result of accidental injury.

2. Injury or irritation resulting in lowered local resistance, destruction of epithelium, *ulcer* formation, or an area of *gangrene*.

3. The accumulation of an unusual number of actively virulent organisms may be sufficient to destroy the protective epithelium and establish a portal of entry, especially when associated with local irritation or lowered resistance.

4. It is claimed that bacteria may penetrate an intact epithelial surface (intestinal) and cause infection in the underlying tissues, with no demonstrable portal of entry. (Examples of "portals of entry": an infected wound, tonsilitis, an abscess in any location, typhoid ulcers in the intestine.)

EFFECTS OF BACTERIA ON THE BODY

The factors which determine the results of a given infectious process are:

A. On the part of the invading organism:

1. The SPECIFIC NATURE of the bacteria in question. Each type of pathogenic organism causes more or less typical results and has a special tendency to attack certain regions or tissues. These peculiarities will be discussed in detail in a later section.

2. The NUMBER of organisms reaching the tissues will, to a certain extent, determine the severity of the process.

3. The VIRULENCE of a given organism varies, and is a most important factor influencing the local and general effects of bacterial invasion.

B. On the part of the **individual thus infected:**

1. SPECIFIC PROTECTION, that is, certain persons have acquired an especially increased resistance or relative *immunity* to a given type of pathogenic micro-organisms. In the case of a few of the non-surgical infections, this immunity may be hereditary. More often it is acquired by previous exposure to a relatively inactive process caused by the organism in question, or by a mild attack of the disease (smallpox). In some cases it may be developed therapeutically by the use of "vaccines," *i.e.*, the individual is inoculated with killed organisms of a given type of bacteria.

2. GENERAL RESISTANCE.—Anything which impairs the health of the individual lessens the ability of the body to overcome the activity of the invading micro-organisms. Such conditions include, (*a*) chronic infections, tuberculosis and syphilis; (*b*) constitutional disease, diabetes, arteriosclerosis, nephritis, and certain diseases of the central nervous system; (*c*) alcoholism, chronic intoxication, fatigue, exhaustion, or malnutrition.

3. LOCAL RESISTANCE determines to a great extent the course of the original portal of entry, or primary lesion.

(*a*) The chief factor is the richness of the normal blood supply to the area involved. In regions where this is abundant, a greater number of the invading bacteria are quickly overcome, and the process runs a shorter course. Also, because of the rich vascular supply, there is greater absorption of toxins and more marked constitutional effects. In regions which have a scanty blood supply, as in fatty tissue (perirectal space), invading bacteria meet less resistance, there is greater tissue destruction, and at the same time less absorption of toxins and constitutional results.

(*b*) As a result of pathological change in the vascular system, the normal blood supply is interfered with, and there is decreased resistance to bacterial invasion. Example, partial obstruction of the principal artery to a part, resulting in lessened blood supply; or partial obstruction of the veins from a region,

resulting in stasis of blood in the tissues and a passive congestion, as seen in varicose veins of the limb affected with "leg ulcers."

(c) The normal nerve supply to a region is important in maintaining the "tone" of the tissues, and their ability of resisting invading organisms. Constitutional or local disturbances, which impair the normal nerve supply, seriously lower the local resistance to an infectious process.

Infection or sepsis, the effects of invasion of the body by pathogenic bacteria: These terms refer respectively to: (A) the *local* and (B) the *constitutional* changes which are caused by pathogenic bacteria.
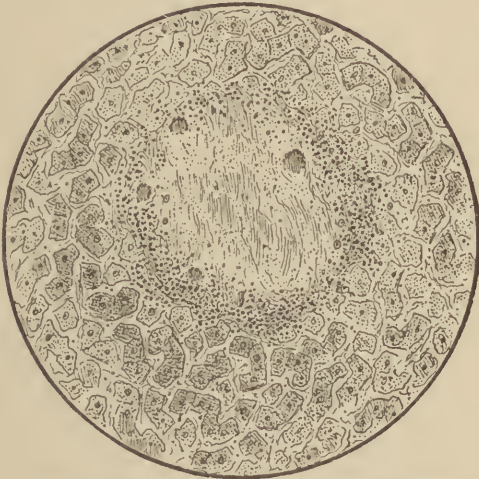
FIG. 3.—Showing tissue changes in inflammation.

A. The **local effects, inflammation,** represent the attempt of the tissues of the body to overcome and destroy invading pathogenic organisms. These changes vary somewhat in special tissues, and with different types of bacteria, but are fairly constant. The details have been studied experimentally and clinically, and a general knowledge of these is important in order to understand the process (Fig. 3).

There is found in the area thus involved:

1. AN INCREASED LOCAL BLOOD SUPPLY. There is an active dilatation of the arterioles, capillaries, and veins, so that more blood passes through the tissues in a given time.

2. BLOOD-SERUM and WHITE BLOOD CELLS (leucocytes) pass through the walls of the capillaries into the tissue spaces. Here the leucocytes attack and destroy invading bacteria, and because of this activity, the term "phagocyte" is applied to them.

3. Development of PLASMA CELLS is observed microscopically in the tissues. These cells have a characteristic appearance and their functions include the formation of a more or less complete layer about the invaded area, which tends to limit the process.

4. SWELLING, due to the increased blood supply and the presence of an abnormal amount of fluid and cells in the tissues.

5. PAIN, as a result of distention of the tissues and pressure on the sensitive nerve-endings. This depends on the density of the tissues, being greater in firm resisting structures (subperiosteal) and less in loose fatty tissues (subperitoneal); where a considerable amount of tissue destruction may develop with but little pain.

6. INCREASED LOCAL TEMPERATURE and REDNESS (if superficial), due to the vasodilatation and increased local blood supply.

The course of the local inflammatory process depends on the factors "*A*" and "*B*" discussed under this section, "Effects of Bacteria."

1. *Resolution*, most favorable. The invading organisms are overcome and killed by the phagocytic activity of the white blood-cells. These, together with any *necrotic* (killed) body and blood-cells, are entirely absorbed, and the process is terminated spontaneously.

2. *Suppuration*, less favorable. In this case large numbers of tissue and blood-cells are destroyed, forming pus. *Pus* is fluid, consisting of dead (necrotic) blood-cells, tissue cells, blood-serum, and usually contains bacteria, some killed and some actively virulent. The local process in diffuse tissues is spoken of as "cellulitis," and later forms a definite "abscess." As a result of the presence of fluid pus, the surgeon can usually demonstrate a characteristic sign, *fluctuation*, if the process is superficial. When inflammation has gone on to suppuration, complete resolution rarely occurs, and one of the two following possibilities may result:

3. *Encapsulation* (a favorable process). This consists of a complete walling off of the area of inflammation by a layer,

composed of plasma and connective-tissue cells, which is impervious to the active bacteria or the products of their activity. By this means the abscess or cellulitis is effectively sealed up and localized. Such a cavity contains pus and bacteria, which under favorable circumstances are destroyed, so that eventually the contents are practically sterile, and, theoretically, the mass may be absorbed. An encapsulated abscess is a source of danger in that it may contain pathogenic bacteria of low virulence, which again become active and give rise to an extension of the process if the general resistance is later below normal.

The first two stages can be observed "in miniature" by the course of small papules or pustules in the skin. The milder ones appear as red, painful swellings, representing the reaction of the tissues to pathogenic bacteria which are killed without extensive destruction of body-cells. Pustules result when a certain number of tissue and blood-cells are destroyed, forming fluid pus, visible as a white area at the centre. If the process is deeper it may become sealed off and "encapsulated" as a tender palpable nodule. "Sinus formation" is represented by sloughing of necrotic overlying epithelium and spontaneous discharge of pus.

4. *Unfavorable course*, extension of the area of suppuration, diffuse cellulitis. This process extends and is limited only by dense fibrous membranes, such as "aponeuroses," sheathes of muscles, or peritoneum.

5. *Sinus Formation.*—The most favorable natural result at this stage is a spontaneous rupture of the abscess to the surface or into one of the hollow organs, since this provides an outlet for the septic and necrotic material. Such spontaneous opening is the natural provision for drainage of an abscess, and it will persist as long as there is necrotic material in the cavity. If drainage is complete, the protective tissue develops and fills in the abscess cavity, completing the healing process. In many cases the sinus persists, and it is necessary to enlarge the opening and remove necrotic tissue to secure closure of the cavity. Usually the surgeon is able to anticipate spontaneous sinus formation by incision, and to provide more adequate drainage. This is preferable for the following reasons: (a) Surgical incision provides more efficient drainage, often at a more favorable site; (b) it is done earlier and avoids extensive destruction of

healthy tissue; (c) it allows complete evacuation of the cavity; (d) it leaves healthier tissue and healing is more rapid and complete.

B. **General or constitutional results** are those which are more or less remote from the primary focus of bacterial invasion, causing what is known to the laity as "Blood Poisoning."
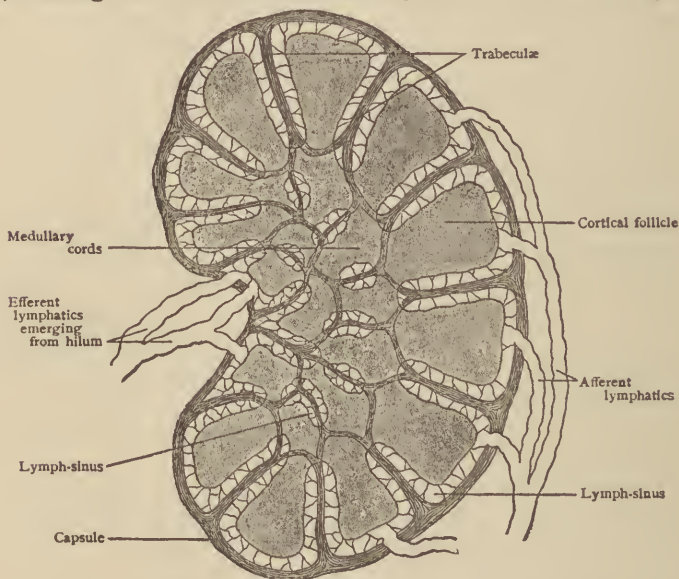
Diagram illustrating architecture of lymph-node.

1. INVOLVEMENT OF THE LYMPHATICS. Lymph vessels drain fluid from the tissues. This fluid (*lymph*) is derived primarily from the blood-serum which has passed into the intracellular spaces in the tissues, in turn it is taken up by the lymph vessels, and enters the venous circulation through the thoracic ducts. The *lymph-nodes* composed of cells representing different stages of developing lymphocytes are located in various parts of the body. They have two functions, (a) supply lymphocytes to the circulating blood; (b) the lymph from the tissues passes through one or more sets of lymph-nodes which tend to overcome and destroy any harmful material, bacteria or toxins, which reaches them. When superficial lymph vessels are involved, this is made evident by red streaks under the skin, representing the lymph vessels. The affected lymph-nodes enlarge in the attempt to overcome the invading micro-organisms and toxins.

The involvement of the neighboring lymph-nodes will persist until the original process has cleared up, or adequate drainage has been provided. Under favorable conditions, extension to more remote parts of the body is prevented and the process in the lymph-nodes subsides without serious tissue destruction, being controlled by prompt and successful treatment of the original lesion. In less favorable cases, extensive tissue necrosis and suppuration occurs in the involved lymph-nodes. It is then necessary to consider this process on the principles of independent abscess formation or cellulitis, spontaneous resolution rarely taking place.

2. Involvement of the blood, LEUCOCYTOSIS, represents a further protective process, and consists of an increase in the total number of white blood-cells in response to the activity of the micro-organisms. This reaction is found in practically all infectious processes, except typhoid and tuberculosis. A leucocytosis is demonstrated by a "blood count," i.e., counting the white blood-cells in a given volume of a known dilution of blood, using special pipettes and ruled slides, under the microscope. Normally in a cubic mm. of blood there are found from 5000 to 7000 leucocytes, and any considerable increase, i.e., over 8000, is evidence of a leucocytosis. The degree of this reaction is determined by the virulence of the infectious process and the resistance of the individual. Differential counts are made by estimating the percentage of each type of white blood-cell in a stained blood-smear. The relative increase of various forms of leucocytes varies and is of importance in estimating the resistance to the particular infection present.

3. TOXÆMIA, OR SEPSIS. The constitutional reaction due to absorption of toxins and products of tissue destruction is commonly spoken of as "sepsis," and is present to a greater or less degree in all infectious processes. The condition may be (a) acute, i.e., sudden onset, rapid increase in the severity of symptoms, which may either go on progressively to a fatal termination, or clear up rapidly following a more or less definite "crisis" in response to treatment; (b) a chronic condition of sepsis may follow an acute process, or in other cases is chronic from the beginning.

The evidences of acute sepsis are: (a) Chill at the onset or associated with a suddenly increased absorption of toxic prod-

ucts. (b) Fever, a sharp rise of temperature to 103° or higher, which may be irregular. (c) Increased pulse, to 120 or more, usually in proportion to the fever. The pulse-rate rises with the severity of the toxæmia, and in serious cases becomes weak and irregular. (d) Headache and malaise are usually present.

The *chronic* type of *sepsis* is gradual in onset or may represent the termination of an acute process. Fever is rarely as high as in the acute type and is quite irregular, with characteristic morning and evening variations. The pulse-rate is also increased and variable. The process is slow in progress and clears up gradually, or the patient becomes progressively weaker, and dies. In the long-standing cases there is marked malaise, cachexia, malnutrition, with kidney changes, albuminuria, or anuria.

Significance of Constitutional Symptoms.—These always indicate the presence of an active focus of infection from which toxic material is being absorbed. (a) When such symptoms arise spontaneously in a patient previously well, it is necessary to locate the primary lesion and treat the condition as may be indicated. (b) The persistence or recurrence of evidences of sepsis after a local lesion has been treated surgically indicates that drainage is insufficient, or that some lesion has been overlooked. (c) The development of fever and other symptoms following a clean surgical operation should be taken as evidence of infection in the wound.

4. SEPTICÆMIA (literally septic blood) is characterized by the presence of pathogenic bacteria in the circulating blood. Bacteria from a focus of infection reach the neighboring veins, are taken up by the general circulation, and are carried to all parts of the body. Demonstration of the organisms in the circulation is made by means of bacteriologic cultures of blood drawn, under aseptic precautions, from a superficial vein.

Significance: Such a condition is evidence of a virulent infection which has overcome the defensive processes, and indicates a grave prognosis.

5. PYÆMIA refers to a condition when there are multiple areas of infection in various parts of the body. The veins in the tissues about the primary infectious focus contain "thrombi," *i.e.*, clots, in which are found virulent pathogenic bacteria. Parts of these thrombi loosen, are carried in the blood as "emboli,"

and later lodge in remote parts of the body, giving rise to many secondary areas of infection. Pyæmia develops when general resistance to the specific causal organisms is exceedingly low. The condition indicates a bad prognosis.

Principles of Treatment.—There are three indications:

A. To cut off the absorption of toxins from the local focus of infection.

B. To promote the elimination of toxic material already absorbed.

C. To increase the general body resistance, and, in certain cases, also the specific resistance to the causal pathogenic organisms.

(*A*) **Local Treatment.**—As soon as it can be demonstrated that there is a definite local lesion accessible to surgical treatment, attempts are made to control the infectious process at this point. (1) The ideal method is an "excision," removal of the entire focus, which is possible only when the infection is limited entirely to a structure which can be removed surgically; example, an acutely inflamed appendix in the early stage. In case this is successful, there should be a prompt cessation of constitutional symptoms, and any recurrence is evidence of a continuation or extension of the original focus. (2) In cases where excision is not possible, the surgeon attempts to control the process by (*a*) incision of the abscess, (*b*) evacuation of necrotic and septic material, and (*c*) provision for adequate drainage. When this is accomplished, evidences of sepsis should disappear, provided drainage is good and there is no extension of the abscess. (*d*) Drainage is stimulated by measures which increase the local blood supply: hot, moist dressings, hyperæmia by special apparatus, and tubes to keep the incision open till the cavity heals from the bottom. Otherwise septic material is retained and may be encapsulated. (*e*) Local resistance is also increased by these measures and by immobilization and elevation of the part. An ice-bag is of value to relieve pain, but does not increase local resistance.

(*B*) **General Treatment.**—By this we endeavor to secure (1) *elimination* of toxins already absorbed; (2) to increase the *general resistance*, and (3) the *special resistance* to the particular infection involved.

1. ELIMINATION of toxins is accomplished by stimulating all of the excretions of the body: (*a*) Skin, by various forms of

hydrotherapy, cool or cold baths or sponges as for fever; sponges and alcohol rubs to improve the circulation of the skin. *Sweating* is induced by hot drinks, heat externally, and special drugs, "diaphoretics," Ex. Dover's powder, aspirin or "coal-tar" products, which also tend to reduce temperature. (*b*) The kidneys: Large amounts of water or fluids are given by mouth to increase the excretion of urine, "diuretic" drugs, potassium citrate, cream of tartar, lemonade, are used to stimulate the activity of the kidneys and also the elimination of toxins resulting from sepsis. (*c*) The bowels: Constipation is a common condition in many of the acute and chronic infections. An active cathartic, such as castor oil, magnesium sulphate, or a single dose of calomel, followed by a saline (magnesium sulphate or citrate) is usually indicated at the onset as a part of the initial treatment of most acute infections, except where there is a possible involvement of the peritoneum. After this it is necessary to keep the bowels well open by the use of milder cathartics or enemas.

2. The GENERAL RESISTANCE of the individual is maintained and increased by medical and hygienic measures, particularly: (*a*) Rest in bed, at an even temperature, thereby conserving the energy of the body that it may be used in overcoming the infection. (*b*) Nourishment which the individual can digest and which will supply the greatest amount of energy. Forced feeding and special attention to provide attractive, nutritious foods, which will be easily digested, is always necessary. (*c*) Air and sunshine are most important in securing rest, sleep, stimulating the appetite, and improving the general well-being of the patient. If weather permits, treatment on a sun-porch or in the open air is often advised. (*d*) Drugs are of secondary importance, being indicated to meet special conditions: Diaphoretics, diuretics, or cathartics, as already mentioned; tonics and bitters for the appetite; camphor, digitalis, or strychnine, as indicated for special stimulation; iron or arsenic for anæmia, morphine or hypnotics to relieve pain or secure sleep. Specific medication: Quinine for malaria, potassium iodide, mercury or arsenic preparations for syphilis.

3. The SPECIFIC RESISTANCE to certain special infections may be increased: (*a*) By the use of *vaccines;* the injection of killed bacteria of the type causing the infection, which increases

the body resistance to these particular organisms. These may be (i) autogenous vaccines, *i.e.*, bacteria which are grown on laboratory media by implanting some of the discharge or secretion from the lesion under treatment. These are supposed to be more definitely specific in a given case. (ii) Stock vaccines containing various combinations of organisms are on the market and are extensively used where the specific causal organisms can be demonstrated. (b) Antitoxic serums are used in infections where the causal organisms produce soluble toxins. Example, tetanus, diphtheria. (c) Tuberculin in some form is used specifically in suitable cases of surgical tuberculosis.

The student nurse must realize that aseptic surgical technique is based on methods and principles commonly used in the bacteriological laboratory. Experiments such as are here outlined will demonstrate the principles involved better than any written or spoken descriptions. It is recommended that these be given preceding the service in the operating, delivery, or dressing rooms.

Each hospital has or should have, written detailed instructions for the aseptic preparation and preservation of all kinds of instruments, apparatus, dressings, and solutions. These must be presented to the class with each step of the procedures carefully discussed. The sterilizers, tables, and accessories in the operating room should be explained and demonstrated so that the nurse is thoroughly familiar with the mechanism involved. Formal demonstrations of the names, uses, and care of all instruments and apparatus which the nurse is expected to prepare will be of great value. Such work can be most advantageously presented to small groups as they take up their practical training, rather than before large classes.

PRACTICAL DEMONSTRATIONS, WHICH WILL DO MUCH TO MAKE REAL THE PRINCIPLES AND FACTS DESCRIBED IN THE PRECEDING PAGES

I. To show the effects of sterilization and the possibility of bacterial contamination.
  1. Take two sterile petri dishes filled with culture media (agar).
     (a) Keep carefully covered and uncontaminated.
     (b) Uncover for a few minutes, expose to the air and breathe over the surface. Incubate both dishes at body temperature, and study in 24, 48, and 72 hours.

2. Take two petri dishes as before.
   (a) Into one introduce a sterile surgical needle under absolute aseptic precautions.
   (b) Into the other dish, and under the same precautions, introduce a needle which has been sterilized but which subsequently has been handled and passed through soiled dressings. Incubate as before and study after 24, 48, and 72 hours.
3. After thoroughly washing the hands in soap and water (no antiseptic) scrape the skin with a sterile knife-blade and allow the loosened epithelium to fall on the surface of a sterile agar plate. Incubate and study as in other experiments.
4. After having prepared the hands as for surgical cleansing and subsequently rinsed thoroughly in sterile water, to remove any antiseptic, loosen bits of epithelium about the roots of the nail and under the nail, and drop on the surface of an agar plate with all aseptic precautions. Incubate and study as before.

II. To show bacterial contamination of body surfaces.
   1. (a) Carefully swab the region of the tonsil with a sterile applicator and wipe off on a clean glass slide. Allow to dry and "fix" by passing through an alcohol flame 5 or 6 times. Stain with a few drops of aqueous solution of methylene blue, wash, dry and study under the oil immersion.
      (b) Inoculate an agar tube of media with a second swab, incubate and study after 24, 48, and 72 hours.
   2. Collect a few drops of vaginal or urethral discharge.
      (a) Make a smear of a clean glass slide, fix and stain with methylene blue. (i) Under the low power microscope, study vaginal or urethral epithelium and pus cells. (ii) Under the oil immersion, study bacteria and pus cells.
      (b) Inoculate tubes or plates of suitable media, incubate and study.

III. Make the same demonstrations from an open ulcerating surface.
IV. Have the nurse make a leucocyte count from a suitable case.
V. Study "blood-smears" under the oil immersion and demonstrate various types of leucocytes.
VI. From the hospital wards select suitable cases for demonstration, or at least case-histories for special study, as follows:
   (a) Local infection, "felon," with constitutional symptoms.
   (b) Local infection, superficial abscess, with lymphatic involvement, if possible accompanied with suppuration in the lymph-nodes.
   (c) A chronic discharging sinus, osteomyelitis, before and after radical surgical treatment.

CHAPTER II

COMMON TYPES OF LOCAL INFECTIONS, "PORTALS OF ENTRY"

CERTAIN forms of local inflammatory lesions warrant special mention:

A. **Cellulitis** represents the most common local process. It begins diffusely in the tissues associated with inflammatory reaction, attempts at localization, encapsulation, or abscess formation. The severity of the reaction depends upon the richness of the blood-supply in the area involved, being less active in loose fatty tissues (perirectal or perirenal regions), where extensive suppuration and large abscesses may develop with but few localizing symptoms. Such abscesses tend to spread by gravity or by continuity in the tissues, being limited only by the more dense fibrous membranes: periosteum, aponeuroses or sheaths of muscles. Example, tuberculosis of the lumbar vertebræ, "Pott's disease," often extends into the psoas muscle, which is attached to these bones. Suppuration takes place in the muscle sheath, forming the "psoas abscess," which "points" or tends to open near the insertion of that muscle in the groin.

"COLD ABSCESSES" are those which develop with but slight local reaction, and there is relatively little evidence of inflammation, hence the name cold abscess. The process is often tubercular.

B. **Sinuses** are spontaneous openings from an abscess which has extended to the surface and has destroyed the superficial layers. A sinus provides an outlet for toxic and necrotic material, but such drainage is usually less efficient than that obtained by free surgical incision. A sinus persists usually as long as necrotic material remains in the cavity. Premature closure results in the encapsulation of the abscess, which may later break through and discharge. This is especially marked when the sinus communicates with a cavity containing necrotic bone, as in a long-standing case of osteomyelitis.

SECONDARY INFECTION of the walls of a sinus and abscess cavity frequently occurs from bacteria present on the surface, and not the original cause of the infection. Example: A tuberculous abscess with a sinus often becomes contaminated with staphylococci, the walls becoming thickened and indurated. A sinus may also follow a surgical incision into an abscess as a result of secondary infection or incomplete drainage.

Non-operative treatment consists of injection of the sinus and cavity, with antiseptic mixtures; example, bismuth paste, but is ineffective when there are masses of necrotic material in the cavity. A Röntgen ray plate taken after the injection of the sinus with bismuth mixture is of value in determining the position of the abscess and the course of the sinus.

Surgical treatment aims: (1) To evacuate necrotic material from the cavity, and is accomplished by free incision, removal of broken-down tissue, by the curette if necessary; (2) to provide healthy walls, by curetting the surface, application of strong antiseptics, phenol or iodine, or, most often, by the excision of the entire tract; (3) to secure complete closure from the bottom of the cavity by packing with iodoform gauze, which is gradually withdrawn.

C. A **fistula** is an abnormal opening between one of the hollow organs and the surface of the body, or between two adjacent hollow organs. The subject is discussed in this Section, since it is often due to, or is usually complicated by, local inflammatory reactions.

The causes of fistula are:

1. CONGENITAL, MALDEVELOPMENT of the walls of the body or of an organ. Example: Of the rectovaginal septum, resulting in rectovaginal fistula. These are comparatively rare.

2. TRAUMATIC: Penetrating wounds, or severe pressure extending from the skin or mucous membrane to one of the ducts or cavities. Examples, (a) involving the parotid duct, causing salivary fistula opening on the cheek; (b) between the vagina and bladder, from pressure or injury at confinement, resulting in vesicovaginal fistula; (c) rectovaginal fistula resulting from incomplete healing of an obstetrical laceration of the perineum into the rectum.

3. NECROTIC or INFLAMMATORY, extension of an abscess to both surfaces of adjacent organs. Examples, of a perirectal

abscess into the rectum and also to the skin of the perineum. A "fecal fistula," resulting from the breaking down of a necrotic cæcum into an appendectomy wound. Ulceration and extension of a malignant new-growth.   Example, cancer of the cervix of the uterus into the bladder.

4. THERAPEUTIC or SURGICAL FISTULA. Examples: (a) *Cholecystostomy*, drainage of the gall-bladder or fistula formation, which is done for drainage of the infected bile to the surface of the body. (b) *Gastrostomy*, an artificial opening into the stomach, is made for feeding when there is an impassable obstruction of the œsophagus. (c) *Colostomy*, opening into the large intestine, is made to provide an artificial anus for drainage when there is a permanent obstruction in the lower bowel or rectum.

A fistula is characterized by copious discharge of contents from the cavity with which it communicates, thus preventing any tendency to spontaneous closure, and requires frequent change of dressings or the use of special apparatus. Persistence of certain types of fistula is the rule, and there is no tendency to spontaneous closure where one or both of the following factors are present: (a) The fistulous tract may be lined with epithelium or an infected granulating surface, which prevents spontaneous healing. (b) There is partial or complete obstruction to the normal outlet of the organ involved and its secretions or contents overflow through the fistula, thus maintaining the opening. Cure is spontaneous in many types when the condition is of short duration and there is no obstruction to normal emptying of the organ in question. *Surgical cure*, to be successful, requires (a) that any obstruction to the normal outlet be removed; (b) that the fistulous tract be excised; (c) that the wall of the organ be closed separately from the surface, and, if possible, that one or more layers of tissue or fascia be interposed.

D. An **ulcer** is a superficial necrosis of surface epithelium associated with infection and local inflammation. The effects may be entirely local, or the ulcer sometimes serves as the portal of entry for serious general infection, with constitutional effects. Example, typhoid fever.

The CAUSES are:

1. *Destruction of the surface* epithelium by (a) injury, irritation or burns; (b) infection from pathogenic organisms on the

surface or carried to the area by the blood stream; there is predisposition to local infection on account of the necrotic or devitalized tissue cells; (c) breaking down of superficial tumors or new-growths, due to pressure and necrosis of the overlying epithelium. This occurrence always suggests the possibility of malignancy in the tumor, and is an indication for adequate surgical treatment.

2. *Predisposing causes* are: (a) *Local:* (i) Deficient blood supply normally. Ulcers are more frequent and persistent in regions which have a relatively poor blood supply (anterior tibial surface). (ii) In regions where the blood supply is deficient because of local disease or accident, local arteriosclerosis or varicose veins. (iii) Defective nerve supply and loss of "tone." Example: bed-sores and ulcers in parts which are paralyzed, especially in case of injury to the spinal cord. (b) *General:* Constitutional disease: syphilis, diabetes, arteriosclerosis, severe malnutrition or cachexia. In such condition healing of slight superficial injuries is slow and incomplete. Resistance to invading pathogenic bacteria is low, therefore local infection of the wound or "ulceration" follows.

LOCATION.—Ulcers may be found on any epithelial surface, *i.e.*, skin or mucous membrane, especially in regions exposed to irritation and infection. They are more persistent in regions where resistance is normally low or is impaired by pathologic changes. Example: the mouth irritated by carious teeth, the stomach by the acid gastric juice. Low local resistance of the leg on account of the poor venous circulation is often increased pathologically by varicose veins or constitutional disease. As a result, minor injuries with slight destruction of tissue, instead of healing promptly, become infected, form open ulcerations, and resist ordinary local treatment.

TYPES OF ULCERS.—Varicose ulcer, on the leg, associated with varicose veins. Syphilitic ulcers resulting from broken down gummas tend to extend at the periphery in spite of local treatment. Gangrenous ulcers, associated with low resistance, prolonged infections and virulent bacteria, spread rapidly, with marked tissue destruction. Malignant ulcers, due to breaking down of the epithelium over superficial malignant new-growths.

COURSE OF HEALING.—A wound with superficial tissue

destruction heals normally in a definite manner.   There are three stages:

1. Tissue which has been destroyed is thrown off or *sloughs*. This process may take several days and the necrotic tissue is easily infected.   The superficial wound opens channels for the spread of infection in tissue spaces, and the absorption of toxins.   Hence an ulcer is truly a localized infection or portal of entry.   Toxic symptoms are usually mild and extension is not marked, since the process is superficial and there is free drainage.   *Danger of pockets and scab formation:*   When the surface is covered or there are deep cavities with overhanging edges, the process comes to resemble true cellulitis or abscess, extends, and causes constitutional effects.

2. The development of *granulation tissue* over the base and at the edges of an ulcerating surface serves two purposes: (*a*) Limits the extension of the infection and prevents the absorption of toxins; (*b*) fills in the space left by destruction of tissue and aids in the healing process.

3. *New epithelium* develops at the edges and grows toward the centre as the granulation tissue reaches the surface.   This extension of epithelium is retarded as long as the surface is infected, or is often further delayed by excessive development of *exuberant granulations*, "proud flesh," which project above the surface and prevent the overgrowth of epithelium from the edges.   Any undue delay in the progress, with persistence of an open infected area or ulcer, is usually due to some of the predisposing causes.

COMPLICATIONS AND SEQUELS.—1. *Scab-formation* over the surface, or the extension of an ulceration under the edges, results in absorption of toxins with constitutional symptoms and further spread of the local process.   It is obvious that such cavities should be promptly opened, overhanging, necrotic flaps removed, and free drainage secured.

2. *Persistent Infected Granulations.*—As the result of various predisposing causes, the granulation surface on the floor of an ulcer shows no tendency to heal over, becomes non-vascular, with a purulent discharge.   In such cases it may be necessary to remove the surface infected granulations by curetting or cauterizing down to healthy tissues, and to treat the particular predisposing factors.

3. *Cicatricial contraction* and deformity occur in certain types of ulcers with extensive loss of tissue, especially burns of the skin or ulcers of the hollow organs, œsophagus, stomach or intestine. These latter often cause constriction of the lumen, occasionally leading to an impermeable "stricture." Suitable plastic operations or anastomoses between the hollow organs are often necessary to correct the condition.

4. *Malignant growth* in an ulcer is important from two standpoints: (a) The condition may be malignant from the start; in other words, a superficial malignant growth becomes evident as an open ulcer which extends in spite of the ordinary treatment. A superficial tumor (mole, or wart), which becomes ulcerated, must be regarded as malignant, and excised without delay. Therefore an ulceration which resists local treatment and with no adequate predisposing cause should be regarded as malignant and so treated, *i.e.*, excised, and a suitable plastic operation done. (b) Malignant degeneration in the healing of certain chronic ulcers is claimed to occur as a result of atypical epithelial development. The relative importance of this possibility cannot be discussed in detail, but it must always be kept in mind in the case of certain chronic ulcers. Examples, those of the stomach, also those of the skin resulting from X-ray burns.

TREATMENT.—This must meet two indications, (1) the local condition; (2) the particular predisposing cause.

1. *Local treatment* is limited to ulcers of the skin and is considered under four heads: (a) To provide healthy tissues for healing by granulation; (b) to prevent or overcome infection; (c) to avoid all irritation and injury to developing epithelium; (d) to correct deformity.

(a) As a preliminary, the local lesion must, as far as possible, be brought to the condition of an open wound in healthy tissues, to allow normal wound healing by granulation. The surface is thoroughly exposed, necrotic tissue removed, cavities and pockets opened, and free drainage provided.

(b) and (c) To overcome and prevent infection, local dressings of mild antiseptics, moist compresses, dusting powders, or ointments are used. These should also prevent irritation from dressings and stimulate the formation of granulation tissue, and the overgrowth of epithelium from the edges. Exuberant

granulations, "proud flesh," at times interfere with epithelial development and may have to be removed by cauterization or the curette. Open air treatment with suitable protection from the clothes often stimulates rapid healing.

(d) Deformities from contraction of scar tissue often requires special plastic operation.

2. Treatment of the particular *predisposing causes* is often the more important part of the procedure. It may include (a) increasing the local blood supply by hot air, hot moist dressings, or massage; (b) overcoming venous stasis; elevation of a limb, rest in bed, special bandage, or radical cure of varicose veins; (c) special treatment of constitutional disease—syphilis, diabetes, heart or kidney conditions, or malnutrition.

E. **Gangrene** refers to the destruction or necrosis of a part of the body "en masse." Example, a toe, limb or organ, usually as a result of partial or complete interference with the arterial blood supply to the part involved.

The CAUSES are (1) local; (2) indirect; (3) constitutional.

1. *Local.*—(a) Crushing or lacerated wounds; (b) continued pressure resulting in actual tissue destruction; (c) devitalization to a point where resistance to infection is lost and necrosis follows, or (d) separation of extensive flaps or parts from an adequate blood or nerve supply.

2. *Indirect.*—Interference with the normal blood and nerve supply by (a) ligation of the chief artery to a part on account of hemorrhage; (b) local disease of the artery (arteriosclerosis) narrowing or occluding its lumen; (c) tight bandage, cast, or tourniquet, interfering with the blood and nerve supply for a continued period.

3. *Constitutional disease*, resulting in arterial thickening involving certain arteries, cutting off the blood supply to one or more extremities. These diseases include arteriosclerosis, diabetes, and certain remote conditions of the nervous system, Raynaud's disease, locomotor ataxia, and "tone" (vasomotor control) in the tissues which interfere with the normal nerve-supply of dependent regions, especially the extremities.

TYPES.—Two forms of gangrene are described: 1. *Moist gangrene*, which occurs as the result of a sudden blocking of the arterial blood supply, most often associated with crushing injuries. The part involved contains fluid, blood and lymph,

and the tissues are therefore moist. Infection, particularly with the "gas bacillus," and sepsis are more frequent and early in this form of gangrene.

2. *Dry gangrene*, the more common form, is the result of gradual interference with the principal blood supply to a part.
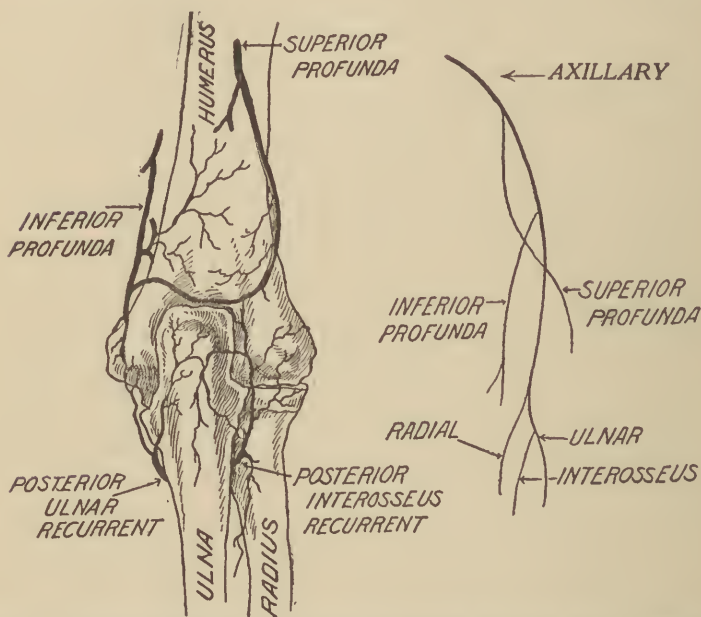
Fig. 5.—Showing anastomoses and collateral circulation about the elbow. Posterior view.

Example: arteriosclerosis, causing gradual obliteration of the lumen of an artery. The most dependent parts, *i.e.*, toes, are first involved, and the process spreads slowly till it reaches a region where the circulation is adequate. "*Collateral circulation*" (see anatomy) is provided by anastomoses between various branches given off from the principal artery at different levels, and furnishes a reserve blood supply to most regions (Fig. 5). This is rarely adequate when the main artery is suddenly, completely occluded, but will develop to a varying degree, and may compensate for gradual occlusion, preventing extensive gangrene. *Infection* is a constant danger in dry gangrene but is not so

urgent as is the case with the moist form, and radical treatment is often delayed to determine the extent of the co-lateral circulation.

COURSE AND SYMPTOMS.—Moist gangrene is evident from the beginning by the appearance of the tissues, which are swollen, dark, and rapidly undergo decomposition as a result of infection. Prompt radical removal of such gangrenous structures is urgently indicated to avoid sepsis. Dry gangrene causes more or less characteristic premonitory changes and symptoms: 1. A peculiar numbness and tingling, and loss of sensation is often noted months before actual gangrene is present. 2. Coldness and poor circulation. After light pressure is applied to the skin and suddenly removed, the return of the normal pink color is delayed. The part chills easily and does not perspire freely; pulsation in the arteries is less evident. The more dependent parts gradually turn dark, finally black, and gangrene is complete. The process extends upward to a varying extent and finally develops a definite *line of demarcation* between the gangrenous tissues and those which possess an adequate blood supply. It is possible for the entire process to go on as an aseptic one and for the gangrenous part to separate or "slough," resulting in a "spontaneous amputation." Surgical amputation is advised as soon as a line of demarcation has developed to avoid the danger of sepsis. This is done in healthy tissues at certain points of election where the blood supply is sufficient to nourish the flaps and secure healing by first intent.

TREATMENT. 1. *Prophylactic.*—(a) Avoid the ligation of the principal artery to a part, if possible. (b) If this is necessary, or gangrene is already threatening, elevation of the part, hot air, massage, and measures to improve the circulation. (c) Treatment of the particular underlying constitutional disease. (d) Aseptic care of the gangrenous parts to prevent infection. 2. *Surgical Treatment.*—Amputation is indicated to remove dead tissue, which is a source of danger to the individual from sepsis.

E. **Freezing and burns** cause local destruction of tissues.

FREEZING, from exposure to excessive cold, causes a paralysis of the circulation and congealing of the fluids in the tissues. If the area involved is extensive, and has been exposed to a low temperature for a long period, gangrene results before the circulation can be re-established, and amputation is necessary.

In milder cases, only the superficial layers of skin are involved, the surface blisters and peels, while there is a marked painful compensatory congestion and swelling of the deeper structures.

Treatment aims to re-establish the circulation and body temperature of the part gradually. This is done with friction, rubbing or massage, usually with snow or ice, and later soothing lotions to relieve pain. For the severe cases stimulants are indicated to overcome depression, and later amputation of parts which become gangrenous.

BURNS are caused by fire, boiling water, live steam, certain chemicals, electricity, and the X-ray.

First degree burns, characterized by redness of the skin and but little destruction of tissue. They are painful but there is no scarring or contraction of tissue in healing.

Second degree burns cause blebs and blisters on the surface, are very painful, and easily infected, so that healing is slow.

Third degree burns include all in which there is actual destruction of tissue up to the point where a part is entirely destroyed. In all of these, especially when the muscles and tendons are involved, there result deforming contractures from scar tissue.

Effects are (1) *local*, as already considered; (2) *general* or constitutional: (a) pain, (b) shock, and (c) toxæmia, all of which vary with the *extent*, rather than the *degree* of the burning. It is usually stated that a burn which involves one-third or more of the surface of the body is fatal. Pain is severe on account of the exposed nerve endings, and often causes a high degree of shock which may be fatal. Toxæmia, resulting in kidney lesions, may cause death after some days. This toxæmia is not clearly understood, but is often most serious. In cases where flame or smoke has been extensively inhaled, an acute œdema of the lungs may develop within a few hours. This is likely to result fatally in spite of active treatment.

Treatment, is both *local* and *constitutional*. There are three general considerations: 1. Relieve pain by comfortable dressing and proper doses of morphine or opium.

2. Prevention of shock and depression by relief of pain and later by proper stimulation with Caffeine, hot coffee by the mouth or rectum, and camphorated oil.

3. To prevent toxæmia and supply fluids.

Local dressings. For the relief of pain it is well to be familiar with agents which are easily obtained. Solutions (10 to 20%) of Sodium bicarbonate (Baking Soda), applied on soft clothes and kept moistened are most comforting. Most surgeons who have used the *paraffin dressing* prefer this method and it presents many advantages. It is comfortable, easily changed, promotes rapid healing with a minimum of scar or contraction. Numerous preparations and combinations of paraffin are on the market but one can use the common form which is found in most kitchens during the canning season.   It is melted in a water-bath or double boiler and held at a low melting point. The burned area is carefully cleansed with an irrigation of boric acid, blisters and sloughs are removed as rapidly as possible and the surface dried by fanning.   The paraffin may be applied with a spray from a special atomizer to form a thick coating.   A simpler method is to place an open layer of sheet wadding on the surface and to apply the melted paraffin lightly with a thin varnish brush to form an impervious layer.   This may be protected by a light bandage if necessary. The dressings are easily changed every second or third day. The burned area fills in rapidly and new epithelium is protected from irritation.   Healing takes place with a minimum of pain, the resulting scars are firm and pliable, so that deformity is unusually absent.

Where the burns are deep or extend about joints, special splints or apparatus may be necessary to prevent contraction of scar tissue which might result in permanent deformity.   In certain neglected or serious cases, secondary plastic operations may be necessary to correct deformity from contracting scars.

Occupational Therapy adapted to special cases will do much to restore useful functions.

DEMONSTRATIONS

1. Psoas abscess with Röntgen ray plate showing tuberculosis of spine.
2. Perirectal abscess and sinus injected with bismuth and Röntgen ray plate or picture.
3. Various types of fistula.
4. Leg ulcers.
5. Ulceration of malignant growth.
6. Case of gangrene, with history.
7. Various types of burns, electric and Röntgen ray.
8. Scar tissue contraction and deformity.
9. Demonstration of "first aid" methods and apparatus, especially that for paraffin treatment.

CHAPTER III

EFFECTS OF SPECIFIC PATHOGENIC BACTERIA

Two types of infectious processes are described:

Acute infections, which are characterized by a sudden onset, severe, rapidly increasing symptoms, a short course, with marked toxæmia and constitutional effects. There is either an early fatal outcome, or a fairly rapid recovery associated with a more or less definite " crisis " after which time it is evident that the infective organisms have been overcome. The classical example of an acute infection is lobar pneumonia, but certain surgical lesions belong to the same type, at least as regards onset, and recovery, after suitable surgical procedure, is prompt and complete. Examples, acute osteomyelitis appendicitis, or certain abscesses.

Chronic infections refer to certain conditions which are more gradual in their onset and course. The constitutional effects are less violent, but are quite definite and may increase progressively to a fatal outcome. Tuberculosis represents the most characteristic of the chronic processes, but the term includes almost any infection which extends over a long period of time.

Infectious processes call for surgical interest: (a) When they present a local lesion which can advantageously be removed, *excised* (acute appendicitis), or opened and drained, *incised* (osteomyelitis). (b) When there are superficial ulcers, sinuses, fistulæ, strictures, or deformities to be treated. (c) Certain of the specific infectious fevers (typhoid) which cause conditions demanding surgical treatment, or which cause complications in post-operative recovery, are of interest.

The diagnosis of the specific pathogenic organisms which are causing a particular infection is important (a) to determine the methods of treatment, particularly if vaccines are to be used; (b) for the production of autogenous vaccines; (c) for prognosis.

METHODS OF DIAGNOSIS include many technical laboratory details:

1. Microscopical examination of stained smears of blood, or discharge.

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2. Laboratory study of "cultures" from discharge, or blood, made on special media. "Pure cultures" are obtained when but a single organism is present.

3. Animal inoculations. When it is not possible to isolate the causal pathogenic bacteria, some of the septic material, pus or blood, is injected into laboratory animals (guinea-pigs). The resulting lesions are more or less typical of certain infections, or the organisms can be isolated from them.

Mixed Infections.—This term is applied when two or more pathogenic organisms are isolated from a single infectious process. Examples: Diphtheria and streptococcus from a throat; B. coli and staphylococcus from an abscess.

Secondary infections occur in a local lesion, as a result of contamination from the surface through a sinus or drainage, also rarely from an adjacent septic cavity. Example: A discharging tubercular abscess often becomes infected by staphylococci or B. coli from the surface.

A few of the more common pathogenic organisms which cause surgical lesions will be considered in respect to their particular effects.

A. **Staphylococci,** of which there are several varieties, are found normally on the skin, in the various orifices of the body, the intestinal tract, and lower genital tract.

The LOCAL LESIONS include skin abscesses, pimples, pustules, carbuncles, wound infections, and certain types of puerperal sepsis. The organisms are found as secondary invaders in sinuses and fistulæ. There is nothing characteristic about the local process except that suppuration and pus production is profuse.

The CONSTITUTIONAL EFFECTS are comparatively slight except in individuals whose resistance is very low, and in long standing chronic processes.

Principles of treatment include (1) free incision and drainage, or that of special lesions, sinuses or fistulæ; (2) constitutionally, measures to increase the bodily resistance. In certain chronic infections, autogenous vaccines are used.

B. **Streptococci.**—These organisms seem to vary greatly in virulence and in their effects. Distribution on the skin, in the throat, intestinal tract, and accidentally in other regions. Strains of virulent organisms seem to be transmitted easily from one individual to another, or from discharges

The LOCAL LESION is characterized by marked redness and swelling, though there is but slight tissue destruction or suppuration.

1. *Tonsils and Throat:* Acute *tonsillitis* and *pharyngitis*, besides the local inflammation, cause severe general symptoms —fever, toxæmia, and prostration. Often there are more remote effects or sequels (endocarditis or acute rheumatism) which persist, or recur, at least till the infected tonsils are removed. 2. *Skin: Erysipelas* occurs as a wound infection, or spontaneously in an unbroken skin, particularly of the face. The tissues are red, swollen and painful, though suppuration is rare. The constitutional effects are severe, but recovery is usual. 3. *Puerperal sepsis*, when caused by virulent streptococci, is serious, with a high mortality. 4. *Intestinal tract*, certain surgical lesions (*appendicitis*, or *peritonitis*), when due to streptococcus, give rise to characteristic general reaction.

The CONSTITUTIONAL EFFECTS are severe, with chills, high fever, marked toxæmia, due to toxins absorbed from the local lesion. The pathogenic organisms can be isolated from the circulating blood in the more advanced forms of this infection, in which case the prognosis is unfavorable.

Treatment, locally, is surgical, if possible, with free drainage and antiseptic compresses. Constitutional measures include elimination of toxins, combating toxæmia, and in some instances, "antistreptococcic serums."

C. **Gonococcus.**—These organisms are found in the discharge from local lesions, or articles which have been contaminated by such discharge. *Portals of Entry:* Two regions of the body seem to be particularly sensitive to invasion by this organism: (1) the urethra and mucous membrane of the vagina, cervix, and uterus; (2) the conjunctiva, especially of the new-born.

1. GONORRHŒAL URETHRITIS, or VAGINITIS, is usually the result of venereal exposure, though it may be acquired innocently from contaminated articles, towels or instruments. The latter method is particularly important in children's wards, where the patients are often poorly nourished. The process especially in adults extends rapidly to the cervix and endometrium of the uterus, or the Fallopian tubes, where it usually becomes chronic. The *surgical lesions* resulting are (*a*) abscess of Bartholin's gland in the labia majora; (*b*) peri-urethral

abscess; (c) chronic endocervicitis; (d) salpingitis, inflammation of the Fallopian tubes, and pelvic peritonitis. Constitutional effects are mild in the early cases, though there is moderate prostration and fever in the severe forms, especially pelvic peritonitis, where there is also marked local pain and tenderness.

Treatment.—Locally, this varies with the form of the lesion. Drainage is provided for infected surfaces, and local applications or irrigations are used. Abscesses are incised, if superficial, or when there is danger of spontaneous rupture. In other cases they are allowed to become chronic, when the encapsulated mass can be enucleated intact.

2. GONORRHŒAL CONJUNCTIVITIS.—(a) In the adult the infection is caused by septic material from gonorrhœal discharge reaching the conjunctiva. The local lesion is a purulent inflammation of the delicate conjunctival membrane, causing a profuse discharge. The course is rapid and ulcers develop which destroy the cornea over the pupil, or produce opacities in this structure resulting in blindness. The diagnosis is made from stained smears. The *treatment* is essentially local and consists of instillations of strong silver preparations, silver nitrate or argyrol, and frequent irrigation with mild antiseptics, boracic acid solution.

(b) In the new-born, the infection (*ophthalmia neonatorum*) occurs at birth from septic secretions of the mother's birth canal, and the course is rapidly destructive on account of the low resistance of the delicate conjunctiva. The disease is the most frequent cause of blindness in the new-born. *Treatment*.— Prophylactic, is the routine instillation of a silver preparation into the conjunctiva immediately after birth, which effectively prevents the infection. It is much better to treat nine cases in this manner unnecessarily than to miss one which is exposed to infection. The diagnosis and treatment are similar to that in the adult, but it must be prompt and vigorous.

D. Other forms of cocci rarely cause surgical lesions. The pneumococcus is sometimes found in pleurisy with effusion, or empyema, and less often in certain forms of peritonitis, characterized by marked and severe constitutional effects.

E. **Typhoid bacilli** are found in water and foods which are contaminated directly or indirectly with excreta of individuals infected with the organism. The "portal of entry" is usually

3

an ulceration of the small intestine, and the constitutional effects are characteristic. In its typical form, the disease is essentially a medical condition, and surgical interest is limited to certain complications or sequelæ: 1. An ulcer may perforate the wall of the intestine, causing a rapidly spreading general peritonitis which is fatal unless surgical drainage is promptly provided. 2. Gall-bladder infections, cholecystitis occurring either as a complication or sequel of the disease, require proper surgical intervention. 3. Local abscesses may complicate and require adequate incision and drainage.

F. B. Coli.—This organism is found normally in the intestinal tract. It causes infection and suppuration in lesions of that tract or adjacent to it. Examples, appendicitis, peritonitis, perirectal abscess. Suppuration is profuse and the odor of the discharge is characteristically fecal, at times to a degree which leads the surgeon to suspect a fecal fistula when none exists. The constitutional effects are not characteristic, and the treatment does not differ from that of similar processes caused by other organisms.

G. Tetanus bacilli are contained in the excreta of horses and stock, and are therefore most often found in stable and street dirt, or fertilized soil. The "portal of entry" is usually an accidental wound contaminated by the above mentioned material. The organism is anaërobic, therefore grows best in the depth of a punctured wound, remote from the surface, with poor drainage. The presence of blood or necrotic material is favorable to its active development.

EFFECTS.—1. Local effects are often delayed for from six to fifteen days, and there is comparatively little suppuration or tissue destruction. 2. Constitutional disturbances are due to the absorption of soluble toxins produced by the bacteria. These poisonous substances reach the central nervous system, probably by way of the peripheral nerves, causing painful "tonic" (*i.e.*, continuous) contraction of the voluntary muscles, which is usually first evident in the muscles of the neck and those of mastication, which explains the common term "lockjaw." Other muscle groups are later involved and the patient eventually dies of exhaustion from pain, sleeplessness, and from starvation.

Treatment.—1. Prophylactic: Includes care of accidental

wounds, free exposure of the wound, evacuation of necrotic material, irrigation with oxidizing agents (peroxide of hydrogen or permanganate of potash) and of drainage to prevent the formation of pockets or the development of bacterial activity remote from the surface. The same treatment of the local wound is indicated later, should constitutional symptoms of the disease develop. 2. Specific: Injection of antitetanic serum or antitoxin. This should be used as a prophylactic measure at the first dressing of all suspicious accidental wounds. By this means constitutional symptoms are effectually prevented. Otherwise, when general effects are evident, the chances of overcoming the infection are decreased, and larger doses of serum are needed. 3. Medical treatment includes (a) measures to relieve pain and muscle rigidity—morphine, chloral hydrate, or other hypnotics; also the use of substances (magnesium sulphate) injected into the spinal canal by "lumbar puncture"; (b) supplying fluids and nutrition by stomach tube, proctoclysis, or enema.

H. Bacillus of Malignant Œdema, " Gas Bacillus."—The distribution is much the same as that of the tetanus bacillus, and the organism is also anaërobic. The portal of entry is usually an accidental wound, especially where there is crushing and extensive destruction of tissue.

EFFECTS.—1. Locally, there is an exudate of bloody fluid in the tissues, in other words an "œdema," accompanied by the formation of gas, which is evident by a peculiar crepitation of the tissues on palpation. The process spreads rapidly in the part, with extreme swelling and tissue destruction. 2. The constitutional effects are severe toxæmia, prostration, usually with a fatal result. The prognosis is grave even with early radical treatment. Principles of surgical treatment are free, deep incision into the wound, irrigation and constant drainage, or amputation with open flaps, if possible.

I. Tubercle Bacilli.—DISTRIBUTION.—These organisms are derived from the sputum of individuals infected with pulmonary tuberculosis or the discharge of active lesions. They are therefore found in the air, dust, and on various articles, especially in the homes or surroundings of those suffering with the disease.

PORTALS OF ENTRY.—Tubercle bacilli enter the body most often through the respiratory tract, and it is stated that the

initial lesion is always in the lung, though this may have caused so little disturbance that it is entirely overlooked by the individual and is not evident in the history as taken by the physician. It seems possible that in some cases the portal of entry may occur in other regions—intestinal tract, tonsils, and rarely in skin-wounds when exposed to virulent tubercle bacilli, *i.e.*, physicians, butchers and veterinarians. The lesions of particular surgical interest are usually secondary, though at the time such local disease may represent the only active process in the body. No region is immune to the organism.

1. Pulmonary tuberculosis is of surgical interest only when complicated by pleurisy or empyema, or as a possible contraindication to surgical anæsthesia.

2. Intestinal and peritoneal tuberculosis is characterized by ulcers and "tubercles," which may cause (*a*) stricture of the intestine and obstruction; (*b*) large inflammatory masses; or (*c*) local abscesses with peritonitis.

3. Urinary tuberculosis usually begins in the kidney, and is at first limited to one organ. The earliest symptoms are referred to the bladder, and the condition is often wrongly considered as a disease of that structure.

4. Female genital tuberculosis is most often evident as a salpingitis, which causes an obliteration of the Fallopian tube, and may represent the beginning of a tubercular peritonitis.

5. The bones and articulations are often involved, apparently as an independent process, particularly in children and young adults. In the long bones, the process starts in the "epiphyses" and extends to the joint surface. The vertebræ are also involved and are complicated by abscesses which often extend to a great distance in the sheaths of attached muscles, "psoas abscess."

6. Lymph-nodes in various parts of the body are infected from a portal of entry in the dependent region drained by the affected nodes, though the original lesion may not be evident. It is more frequent in children and young adults.

EFFECTS.—1. Local destruction of tissue with the formation of characteristic collections of cells ("tubercles"), and suppuration, the latter often being due to secondary infection with other organisms. 2. Constitutional effects include fatigue, loss of weight, fever, especially in the evening, night-sweats, and prostration.

Principles of Treatment.—1. *Local*, rest and immobilization of the affected part to improve the blood supply. In some cases excision of the local lesion is possible, *i.e.*, diseased kidney, or lymph-nodes. Drainage as used for other abscesses is particularly liable to result in persistent sinus formation and secondary infection, and is therefore avoided if possible. 2. *Constitutional treatment* is the most important and must be applied to all forms of the disease, since the special lesion is only a local evidence of a general tubercular infection. Therapy includes all measures to increase the general resistance—rest, improved nutrition, over-feeding, fresh air, sunshine, medicines, tonics, iron, iodine, or cod-liver oil. 3. *Specific treatment* with some form of "tuberculin" is sometimes used to further increase the resistance of the individual. The liability to recurrence is great, and may take place whenever the general resistance falls below normal. Treatment must extend over a period of months or years.

J. The **vegetable parasites** include a group of yeast-like organisms which cause lesions in domestic stock, and sometimes infect individuals peculiarly exposed, *i.e.*, farmers, and those from agricultural districts. 1. ACTINOMYCES causes typical reaction in skin wounds and also about the mouth, jaws, and respiratory tract. Typical chronic inflammatory masses occur which resist local measures, but respond to proper general treatment. 2. BLASTOMYCES, a similar parasite, causes a peculiar inflammatory reaction in the skin, which also resists local measures but responds to internal treatment. These organisms can usually be demonstrated in smears from the lesion, and the treatment is general rather than local.

K. **Syphilis** is caused by the "spirochæta pallida," which is found in the local lesion and also in the blood and tissue fluids during active stages of the disease. There are two forms of the disease, (1) congenital, and (2) acquired.

1. In CONGENITAL SYPHILIS, the offspring is infected *in utero*, resulting in (*a*) abortion; (*b*) premature labor with a still-born or infected baby which shows evidence of an active process; (*c*) a poorly nourished infant which is apparently normal at birth but shows signs of the disease a few years later.

2. The ACQUIRED FORM is caused by contact with discharge or secretion of active lesions, either by venereal exposure, or innocently, by accidental infection of wounds or abrasions of

the skin or mucous membrane. The disease is commonly considered in three stages: (a) Primary, or stage of the initial lesion. The portal or entry consists of a "hard chancre" which is a peculiar inflammatory reaction resembling an ulcer. There is considerable induration and the lesion is rather characteristic. The specific organisms can be isolated in the local tissues or discharge. (b) Secondary stage of general infection follows in from four to eight weeks and is characterized by constitutional reaction, headache, malaise, some fever and prostration. The local lesions in this period are: (i) Skin; painless eruptions which imitate almost all forms of skin disease, but have a peculiar copper color; (ii) mucous membranes, particularly of the mouth and throat, show painless gray ulcers ("mucous patches"), which are highly infectious. (c) The tertiary stage represents a reawakening of the disease which has been temporarily dormant.

Surgical Significance—Syphilitic lesions are more frequent, than is generally recognized, according to Osler the syphilitic taint is more common than the tubercular. The tertiary form of the disease may involve any part of the body and may simulate almost any other type of condition, medical or surgical. Diagnosis is often confusing and difficult. Some of the points to be considered are: 1. The primary lesion presents a more or less typical appearance but this is rarely sufficient to justify a diagnosis. By means of proper technique the specific spirocheta pallida can be demonstrated from the surface of the chancre Previous to the discovery of the specific cause of syphilis, it was considered good practice to delay the diagnosis till the characteristic secondary lesions appeared. This is not necessary now and active treatment commonly begins as soon as the diagnosis is confirmed by test. 2. Secondary lesions are fairly typical, the history is suggestive, and the specific blood test is usually positive. 3. For the obscure late effects, we have the history of primary and secondary lesions, though these may have been obscure and have escaped the notice of an observing and intelligent patient. The diagnosis of the physician will be based upon his clinical judgment of the significance of the history and present condition. The Wasserman test applied to the blood or spinal fluid is commonly regarded as a specific diagnostic reaction. The reaction is a delicate one involving many technical sources of error. It may be negative

in the presence of undoubted syphilitic lesions. In some of these cases a positive reaction can be brought out by a short, rather intensive course of treatment, the so-called "Provocative Treatment." In other instances such a course of treatment brings about definite improvement in the clinical condition and constitutes what may be called a "Therapeutic test."

1. Local lesions often simulate those demanding surgical measures, but fail to respond till anti-syphilitic treatment is given.

2. Syphilis may be present in an individual undergoing surgical treatment for other conditions, and cause serious complications unless active specific therapy is given.

3. Recognition of the disease is important to avoid innocent infections.

4. Certain syphilitic lesions may cause symptoms demanding local surgical treatment in addition to constitutional measures.

Treatment.—General or constitutional treatment to be successful must extend over a period of at least two years. It will consist usually of a sequence of two or more of the three agents mentioned below.

1. Mercury, may be given hypodermically, by inunction or by mouth.

2. Potassium iodide, or sodium iodide, is given in large doses and increased as rapidly as possible to the limit of tolerance, especially in the tertiary forms of the disease.

3. Arsenic, usually one of the special preparations.

DEMONSTRATIONS

1. Methods of preparing and staining smears, and taking cultures.
2. Collection of blood for "blood culture."
3. Method of animal inoculation.
4. A case of persistent sinus with cultures demonstrating mixed infection.
5. A case of erysipelas.
6. Demonstration of cultures from an acute suppurating appendix.
7. Smears from specific urethritis.
8. Study of case history of gonorrhœal salpingitis, with demonstration of specimen removed at operation.
9. Study of case history of typhoid fever showing perforation or other surgical complication.
10. Demonstration of use of tetanus antitoxin and surgical care of suspected wound.
11. Case history of surgical lesions of tuberculosis.
12. Cases showing congenital lesions of syphilis.
13. Cases showing secondary lesions of syphilis.

CHAPTER IV

TUMORS OR NEW-GROWTHS

Definition.—The term *tumor or new-growth*, refers to certain pathological masses of atypical tissue which develop in various regions of the body, and have no useful function. Inflammatory reactions and various forms of compensatory hypertrophy of functioning glands or muscle are excluded. The histologic or microscopic structure is somewhat similar to some one of the body tissues, but is always atypical, showing more or less resemblance to rapidly developing embryonic cells. The development does not follow the usual form, or conform to recognized laws of normal tissue growth. It seems that for some reason the growth has gone wild, loses the typical relations between the constituent tissues, and the entire development is apparently without purpose or order.

Causes.—Three factors (1) parasites; (2) abnormal embryonic development; and (3) irritation or trauma, represent all which are seriously defended as possibly causing new-growths, and none of these are definitely accepted as being the positive cause of all types of tumors.

1. PARASITIC MICRO-ORGANISMS have been claimed as a possible cause of new-growths, and much research work has been done to establish such a theory. There are some points of similarity between certain new-growths and infectious processes. However, no parasite has been demonstrated as being the constant cause of any particular type of tumor. Actual contagion has never been proven clinically. Observations of such apparent cases are best explained as actual implantations of tumor cells, or as coincidence. Examples, two or more members of a family, inhabitants of the same house, or nurse and patient may develop similar type of tumor; but actual contagion, as the term is understood in infections, has not been proved.

2. ABNORMAL EMBRYONIC DEVELOPMENT explains certain tumors. Example, "dermoids," hypernephroma, and some sarcomas of childhood. It is explained that as a result of errors

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of development, bits of tissue are misplaced; epithelium is embedded in connective tissue, and remains dormant for a long period of time. It is stated that such displaced embryonic tissue cells may under certain conditions (repeated irritations) later develop atypically and give rise to a tumor or new-growth.

3. Certain types of IRRITATION are claimed to stimulate an atypical tissue-cell production and give rise to new-growths. A single injury, though often prominent in the history, is usually unimportant as a cause, except for the rare possibility of a typical tissue development in the scar formation in the healing of a fracture, lacerated wound, or burn. However, it is regarded as not improbable that continued irritation, mechanical, chemical or thermal, of epithelial surfaces may lead to atypical development of cells, and become an important causal factor in the etiology of certain new-growths. Examples: 1. Persistent and repeated irritation as a cause of cancer of the lip. 2. A chronic ulcer of the pylorus, being exposed to the mechanical and chemical irritation of the gastric contents, is claimed to undergo changes in the structure and relations of the epithelial cells, resulting in cancer. 3. Cancer of the cervix of the uterus is often preceded by lacerations which are irritated by discharges. 4. Scars of burns of the skin, especially those caused by the Röntgen ray. 5. Certain superficial benign tumors, moles and cysts, which are exposed to irritation or repeated trauma, undergo malignant degeneration. It can be stated definitely that irritation or repeated traumata are at least important causal factors in the development of certain types of new-growths. However, it has not been proven that these factors are the sole cause of, or can of themselves constantly produce, any type of tumor formation. None the less, any ulcer or pathological mass which persists in spite of reasonable local measures, or which is exposed to irritation and trauma, should be considered as a possible developing new-growth, and removed surgically as a preventive measure.

Classification of tumors is based on one of three grounds:

A. Clinical ....
- 1. Benign.
- 2. Malignant.

B. Shape and gross relations
- 1. Mural.
- 2. Sessile.
- 3. Pedunculated.
- 4. Polyps.

	1. Epithelial.....	Benign...	Papilloma. Adenoma.
		Malignant	Squamous cancer. Adeno-carcinoma.
C. Microscopical structure, and tissue from which the growth has developed	2. Connective and supporting tissues, blood and lymph tissues	Benign...	Osteoma. Chondroma. Lipoma. Myoma. Fibroma. Neuroma. Angioma.
		Malignant	Sarcoma. Giant cell. Small round cell. Angio-sarcoma. Melano-sarcoma.

A. **The clinical classification** of benign and malignant tumors is most important. The distinction between the two groups is determined ultimately by the microscopic relations of the cells of the tumor and those of the surrounding tissues.

1. BENIGN OR INNOCENT tumors are characterized by (a) a definite "capsule" of fibrous tissue which surrounds the growth and separates it from the tissues in which it develops; (b) the mass remains localized, and when multiple, each tumor is an independent local growth with a definite capsule; (c) the cells of the new-growth never break through the capsule or invade the surrounding tissues; (d) cells of the tumor do not extend in the lymph or blood stream, and "metastases" or secondary growths do not occur as is the case with malignant tumors; (e) removal is simple and there is no recurrence, provided the growth with its capsule is completely excised.

The *effects* are entirely mechanical: (1) *Pain* from pressure on nerve endings or sensory nerves; (2) *hemorrhage*, from pressure, or erosion of blood-vessels; (3) *obstruction* of hollow structures, from pressure of the tumor—example, blood-vessel, ureter or intestine; (4) *gangrene* or *sepsis* may develop from interference with the blood supply of a tumor; (5) *degeneration* and changes leading to the development of a malignant new-growth may occur under certain conditions, not well understood. Constitutional effects are not specific and depend largely on disturbed body functions due to the mechanical relations of the growth.

Treatment is usually complete excision of the tumor with

its capsule, and there is no danger of recurrence. The indications for such treatment include (1) deformity caused by the tumor; (2) effects (pain, hemorrhage, or disturbed functions); (3) changes (gangrene or sepsis); (4) any suspicion of malignancy. In any case unless this can be positively excluded by a capable surgeon, prompt radical removal is urgently indicated.

2. MALIGNANT NEW-GROWTHS show important characteristics: (a) The cells of the new-growth invade the surrounding tissues. A definite capsule is absent or is broken through by these cells. This is evident, clinically, (i) by the fact that the mass is diffuse and irregular; (ii) that tissue layers, fascia or skin are adherent to the mass; (iii) that there is infiltration about the base of a tumor, or (iv) ulceration of the epithelium over the surface.

(b) The cells of the new-growth sooner or later invade the lymph-vessels and cause enlargement of the neighboring lymph-nodes, and finally give rise to:

(c) "*Metastatic*" or secondary growths in other parts of the body. Therefore complete excision is possible only while the growth is limited to a definitely localized area, before it has extended to the lymphatics, or metastases have occurred.

(d) Recurrence is likely unless the growth is so localized that all of the tumor cells can be removed. This is possible only in the early stage of the process, therefore prompt radical excision is indicated for all suspiciously malignant growths.

Effects.—(a) Local results from pressure occur similar to those from benign growths. Invasion of neighboring tissues or organs is not uncommon, resulting in hemorrhage from epithelial surfaces, ulcerations, fistula formation, and constriction or strictures from development of scar tissue. (b) Constitutional effects are usually secondary to disturbed functions as the result of the mechanical relations of the growth. The constitutional evidences of cancer, when present, indicate usually an advanced, or inoperable stage of the disease. In fact, these effects are often due to the presence of metastatic tumors. There may be severe anæmia from hemorrhage, malnutrition, cachexia, and finally death from exhaustion. It has never been proven that there are specific toxins from the new-growth which cause constitutional symptoms, unless gangrene or sepsis is present.

Principles of Treatment.—A malignant growth is *operable*, provided: (*a*) it is so limited that complete removal "en masse" of the entire tumor formation is possible without injury to vital structures; (*b*) that there are no metastases or extensive involvement of the lymphatics. In many cases a growth is *inoperable* when first seen by the surgeon. This is evident by (*a*) the presence of metastatic masses in other parts of the body—examples, masses in the liver in case of cancer of the intestinal tract; (*b*) extensive involvement of the tributary lymph-nodes; (*c*) extension of the growth into important structures or organs so that complete removal is impossible. The indication is for radical removal of the involved tissues, together with the lymph-vessels and nodes of the area at the earliest possible time. Various local therapeutic measures are used for malignant growths when successful removal is not possible. Some of these seem to retard the development, remove sloughs, destroy local sepsis, and also tend to lessen foul discharge. These measures include the actual cautery, heat with the electro-cautery, radium, and the Röntgen ray; but at the present stage of our knowledge these are reserved for inoperable tumors or are used in connection with radical removal.

Cure.—A patient is considered as cured, following radical operation for malignant disease, only after five years have elapsed with no evidence of local recurrence or development of metastatic growths. However, it is known that these may occur even after this period in rare cases.

From a practical standpoint we should bear in mind the following considerations: Any new-growth is always abnormal and a potential source of danger. The evidences of malignancy as usually described are caused by extension of the growth into surrounding structures and tissues. That when these signs can be demonstrated by the surgeon, the growth is no longer a localized mass which can be easily removed. Tumor cells may already have invaded the neighboring lymph channels or lymph-nodes, or have been carried to remote parts of the body, causing metastases. Therefore, a growth which shows only what we consider as the "early" signs of malignancy has already passed beyond the first stage and is now extending as an actively malignant process. After these signs are evident the chance for successful complete removal, with freedom from recurrence,

and cure is less than one-half as good as before any of these are demonstrated. Furthermore, certain types of growth—pedunculated tumors with irregular blood-supply, or those exposed to irritation—are prone to undergo an atypical cell development or "malignant degeneration," after which extension and metastases occur rapidly. The lessons are obvious.

Any new-growth, including skin tumors, should be examined *at once* by a competent surgeon. Unless he can definitely and absolutely exclude malignancy or the probability of malignant degeneration, his advice will be exploration or radical removal, which should be accepted without question. Any tumor which is causing pain, undergoing change in size, shape or consistency, should be removed at once. There are no "early" signs of cancer which are specific. Any new-growth is much safer preserved in alcohol in a bottle than in the patient's tissues.

B. On the basis of **shape** of the growth and its **gross relations** to surrounding structures, certain terms are used. Most tumors tend to be round except where this is modified by unyielding structures, as bone. *Mural* tumors are located in the wall of a solid organ—example, uterus. *Sub-serous* growths develop immediately under a serous membrane, and may be either *sessile*, *i.e.*, with a broad base of attachment, or *pedunculated*, *i.e.*, with a narrow pedicle which contains the nutrient vessels to the tumor. *Sub-mucous* growths bear the same relation to a mucous surface and, when pedunculated, are often spoken of as "polyps," in which case they project freely into the cavity. Pedunculated tumors are liable to certain complications due to torsion of the pedicle and interference with the blood supply. There immediately results swelling of the tumor with severe pain, and, later, gangrene with sepsis.

C. The *pathological* classification is based on the **microscopical structure** of the growth and the tissue from which it originates. From this standpoint there are two main groups of tissues: 1. The epithelial tissues (squamous protective), secretory (glandular). 2. The supporting tissues and vascular structures, capillaries, and lymphatics.

EPITHELIAL BENIGN TUMORS.—(*a*) Squamous epithelium, *i.e.*, that of the skin, mouth, nose, vagina, and bladder, gives rise to certain "warts," "corns," papillomas, and polyps. (*b*) Secreting epithelium, breasts, glands, intestinal tract, or uterus,

develops benign "adenomas," atypical masses resembling the structure of glandular epithelium.   They usually contain a considerable proportion of connective or fibrous tissue, forming the "adenofibroma" or "adenomyoma."

EPITHELIAL MALIGNANT TUMORS (Fig. 7).—Epithelioma, carcinoma, or cancer. (a) Squamous epithelium gives rise to the epithelioma, a slow-growing tumor which rarely forms metas-
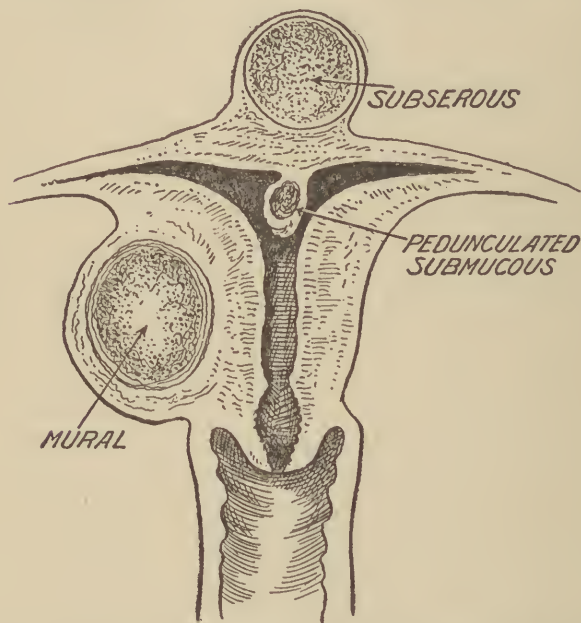

FIG. 6.—Section of uterus, showing types of benign new-growths (fibroids).

tases but resists all local treatment except removal.   The squamous mucous membranes give rise to certain malignant polyps which are much more dangerous than the skin growths. (b) Secreting or glandular epithelium tends to develop the adenocarcinoma, which is rapid in growth and highly malignant. This form of tumor may originate in any structure which contains secreting epithelium—sweat-glands, breast, intestinal tract, uterus, or thyroid gland.

The SUPPORTING and VASCULAR tissues include bone, cartilage, teeth, connective tissue, muscle, blood-forming struc-

tures, lymph-nodes and capillaries. The new-growths may be composed entirely of a single tissue, but more often are mixed, for example, include bone and cartilage, osteochondroma.

BENIGN CONNECTIVE-TISSUE TUMORS may be briefly mentioned:

(a) *Osteoma*, a true ossification, when pure is excessively hard and slow in growth. It often contains cartilage or connective tissue.
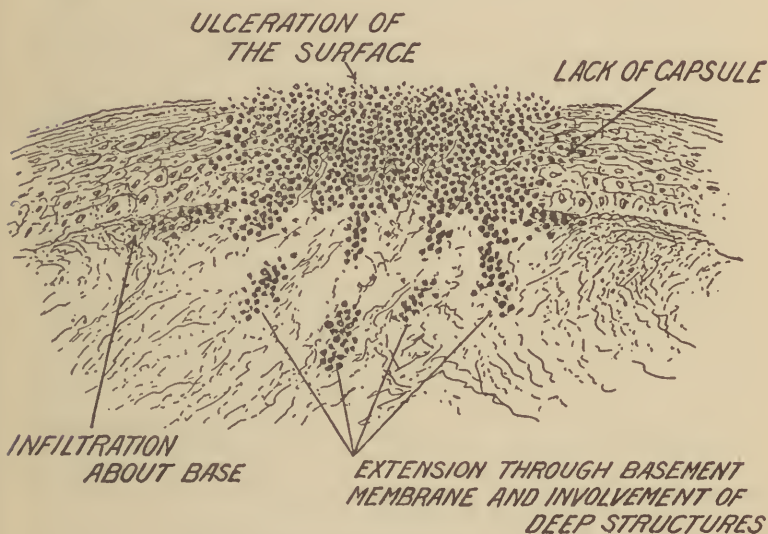

Fig. 7.—Malignant epithelial tumor. Cancer.

(b) *Chondroma*. This growth usually develops from hyaline cartilage and often contains bone.

(c) *Lipoma* is composed of fat similar to that of the subcutaneous structures. Though it rarely has a true capsule, the lipoma is fairly distinct from surrounding structures, and is never malignant.

(d) *Myoma*.—These tumors usually develop from the non-striated muscle, particularly the uterus, and are often mixed with connective or fibrous tissue, forming the "fibromyoma" or "fibroid." See Fig. 6, page 46. The myoma from striated or voluntary muscle, the rhabdomyoma, is very rare.

(e) *Connective tissue tumors*, or true *fibroids*, are rare except combined with other forms where fibrous tissue is present in normal or excessive amounts. Pure fibroids are occasionally found in connection with certain tendons.

(f) *Neuroma* and *glioma* are tumors peculiar to nervous tissues but are really derived from the supporting structures.

(g) Vascular and lymph structures give rise to (1) congenital *angioma* or nævus, also hemangioma, composed of capillaries, and contain blood. (2) *Lymphangioma*, certain moles which may be congenital or acquired.

MALIGNANT CONNECTIVE-TISSUE TUMORS, *sarcomas*, are composed of connective-tissue cells of varying size, on the basis of which we classify them into (a) "giant-cell sarcoma," which is slow-growing and only relatively malignant; (b) "mixed-cell sarcoma"; (c) "small round-cell sarcoma," which is of rapid growth and highly malignant. Of the above mentioned groups, metastases are not common, but local growth may be very rapid, and recurrence is common and rapid; (d) "angiosarcoma," which develops from the lymph structures and is very malignant; (e) "melanosarcoma," so called from the presence of the pigment "melanin" in the tumor cells. This type of tumor originates either in the choroid coat of the eye or in certain pigmented "moles" of the skin, and is extremely malignant. Metastatic growths occur so early and extensively that successful removal is rare.

DEMONSTRATIONS

1. Epithelioma from X-ray burn or other type.
2. Specimens showing different forms of tumors: mural, sessile, and pedunculated.
3. History and X-ray plates showing metastases of a malignant newgrowth in bone.
4. Case history of malignant new-growth from pigmented mole.
5. Specimens and history showing types of cancer.
6. Same for types of sarcoma.
7. Statistics showing comparative results of early and late radical operation.

CHAPTER V

WOUNDS, HEMORRHAGE, SURGICAL OPERATIONS AND ANÆSTHESIA

A **wound** is a break in the continuity of tissues, usually communicating with the skin or one of the epithelial surfaces.

A. CLOSED WOUNDS of the deep structures without communication to the surface are usually the result of serious injury—fractures, traumatic rupture of the internal organs. Example, liver or spleen (from crushing injury or blows with large blunt objects, as planks)—and are followed by evidences of internal hemorrhage or shock.

B. OPEN WOUNDS are those which communicate with the surface, and are the more frequent. There are two types, (1) clean, aseptic, and (2) infected or septic wounds.

1. *Clean, aseptic* wounds are practically limited to elective surgical incisions, made under aseptic precautions, and protected from all contamination by septic material. Clean aseptic wounds may become infected by: (a) A break in the aseptic technic at the operation or subsequent dressing. (b) Development of organisms which have survived the surgical preparation, and have persisted in the deep layers of the skin. These may cause cellulitis, or extend along penetrating sutures to deep layers, forming the "stitch-abscess." (c) Contamination of a clean wound at the operation by the contents of a septic cavity—abscess, intestinal tract, bladder, vagina, or skin. (d) The presence in a wound of necrotic or devitalized tissue cells, collection of blood serum, defective drainage, or tissues constricted by a tight ligature.

2. *Presumably infected* or *septic,* "*dirty wounds,*" include most accidental wounds and those where there is not absolute prevention of contamination by pathogenic germs. Infection may result from (a) the object causing the injury; (b) dirt or foreign material carried into the wound; (c) from the skin or secretions of the body, and (d) penetration of the intestinal tract or any infected cavity. Predisposing factors are: Low general

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resistance as in other infections, and, locally, necrotic or devital-ized tissue in the wound, and poor drainage.

CLASSIFICATION OF ACCIDENTAL WOUNDS.—1. *Incised wounds* are clean cut, resulting from sharp instruments, with no crushing or bruising of tissues, leave healthy, well-nourished wound edges, and, in the absence of infection, heal promptly.

2. *Lacerated or contused wounds* are those with ragged, irregular edges, often with flaps which have a narrow pedicle and insufficient blood supply. The surrounding parts are often crushed and injured, and there may be pockets and cavities; result in poor drainage and with great liability to infection.

3. *Punctured wounds* have a small opening and a long narrow channel or pocket, often extending deeply into the tissues. They include stab wounds, gunshot and bayonet wounds, or those produced by nails and splinters. Foreign material may be carried in and pathogenic organisms, especially anaërobes (tetanus), develop remotely from the surface and oxygen. Drainage is poor and infection frequent.

Repair of Wounds.—A. Clean surgical wounds heal "per primam," or by "first intent," provided infection does not occur. There is no tissue destruction or suppuration and a minimum of scar tissue results. Course of healing: (1) There is an exudate or pouring out of lymph and leucocytes into the wound, tending to fill the cavity. This solidifies and forms a gelatinous cement substance holding the edges together. (2) Capillaries grow into this mass and connective-tissue cells develop, forming granulation tissue, and finally a dense scar or *cicatrix*. (3) The special tissue cells (epithelial or muscular) tend to grow over or into the scar, which is finally covered or replaced to a greater or less extent. This process may be incom-plete, especially in case of extensive scars.

B. Infected or dirty wounds: In these there is more tissue destruction, suppuration is usually present, and the process is much slower. Causes: (1) Anything which prevents the accurate coaptation of healthy wound edges. (2) The presence of necrotic or devitalized tissue. (3) Suppuration. (4) Defective drain-age. As a result of this there is formed more granulation tissue, which is easily infected. This tissue may become exces-

sive or "exuberant" and project above the surface, preventing the final healing by overgrowth of epithelium.

Treatment.—A. Clean-wounds, measures are largely prophylactic: (1) Absolute asepsis; (2) accurate coaptation of healthy edges with no cavity or "dead space"; (3) absolute hæmostasis; and (4) aseptic precautions in the after-care. Should infection occur the treatment is that for infected wounds.

B. Accidental, presumably infected, wounds present three indications: (1) To repair injury; (2) to control hemorrhage; and (3) to prevent infection.

1. Measures to repair injury will depend on the nature of the wound and the tissues involved. Absolute asepsis is the first requisite and any extensive procedure will have to be delayed till the patient can be brought to suitable surroundings, which should be done as promptly as possible. Preparation of the accidental wound for surgical dressing must be done with extreme care to avoid unnecessary contamination. It should be covered with sterile gauze held with a sterile forceps while the surrounding skin surface is cleansed with benzine or some similar agent, avoiding large amounts of water or antiseptic which could carry dirt into the wound. Sterile towels are now arranged about the field as for an aseptic operation, and the necessary procedures are carried out with perfect aseptic technic. . At this time the wound is cleansed of foreign material, necrotic tissue removed, hemorrhage controlled, and severed structures sutured. In deep accidental wounds drainage is often necessary and moist antiseptic dressings may be applied.

In early suitable cases, closure as a clean wound is possible and is preferable since it prevents extensive suppuration. In less favorable cases this cannot be done and special dressings or apparatus are used. The objects are, to destroy pathogenic micro-organisms, render the wound sterile or practically so, and to produce healthy wound edges which may be closed. A somewhat complicated method described as the "Carrel-Dakin technic" is used rather extensively. This involves the use of a preparation of hypochlorite of lime, which must be prepared in a special manner to avoid irritation of the tissues. After proper surgical treatment of the wound, perforated drainage tubes are so placed that all surfaces will be bathed by the solution which is carried through the tubes from an irrigator.

The solution deteriorates rapidly and must be replaced every two hours. Smears are taken from the wound surfaces at regular intervals and are studied under the microscope. When bacteria can no longer be demonstrated the wound can be closed as a clean surgical procedure. The technic is difficult and must be followed to the most minute detail. On this account the method can be used only under somewhat ideal surroundings.

2. Control of hemorrhage is the most urgent indication for first aid and should be accomplished with no unnecessary meddling with the wound. Arterial hemorrhage is the most serious and requires active measures. *First aid, "tourniquet":* This is properly an elastic bandage, though any material may be used in emergency. The bandage is applied above the wound and made tight enough to control the bleeding. In most cases this is sufficient till the patient can be brought to suitable surroundings for surgical care. *Dangers:* A tourniquet which is applied too tightly or left on too long will cause pain and may do serious harm to underlying structures. Therefore the bandage should be only tight enough to safely control bleeding, and is to be removed as soon as aseptic surgical care can be given. If sterile dressings are at hand, moderate hemorrhage can be controlled by packing the wound and applying a tight pressure bandage extending above and below the wound. Direct surgical control of hemorrhage assumes aseptic technic. Arterial bleeding requires ligation (tying) of the artery, always the central end and often, also, the peripheral end. In case of moderate venous or capillary hemorrhage tight suture of the divided tissues is often sufficient.

3. Prevention of infection: This involves perfect asepsis in the first aid and in the subsequent care of the wound. Ordinary aseptic principles are easily overlooked in an emergency, especially when there is serious bleeding. The prevention of sepsis is therefore prophylactic. (a) At the first aid avoid handling the wound, use sterile dressings and mild antiseptic compresses or dressings. (b) Surgical dressing, copious irrigations, removal of foreign material and necrotic tissue, evacuation of pockets and dead space, and ample provision for drainage. (c) The prophylactic injection of antitoxin or serum: example, tetanus antitoxin, in suspicious wounds. (d) Subsequent care of the wound; asepsis and the use of mild antiseptic solutions,

removal of necrotic tissue, and maintaining adequate drainage till healing is complete.

In the care of minor accidental wounds, free hemorrhage should be encouraged, tincture of iodine, or similar antiseptic, applied into the wound (but with no irrigation or antiseptic solution), and a pressure bandage applied to control bleeding, if necessary.

NOTE: Solutions of mercury preparations, especially the bichloride, "corrosive sublimate," must never be used where iodine has been applied, since there is formed a chemical compound which is irritating to the skin. Strong solutions of carbolic acid and its derivatives, lysol and similar commercial preparations have serious local effect on exposed surfaces. They act as local anæsthetics and extensive burns may occur painlessly with no warning to the patient. A few cases of gangrene of finger or toes have developed when strong solutions were used as wet dressings.

Bites of dogs and domestic animals are usually infected and require prompt care—free exposure, cauterization, or strong antiseptics locally—and are allowed to heal as an open wound. If the animal actually has "rabies" or there is reason to suspect this disease, it should be killed at once and the head packed in ice and sent to the nearest public health laboratory for examination. Unless this disease can be reasonably excluded, the patient should be sent to the nearest Pasteur Institute for prophylactic treatment before symptoms are evident. The treatment is specific and prevents the disease if used early in the incubation period, but is much less efficacious after symptoms have appeared.

Hemorrhage may be either (A) open, or (B) concealed.

A. OPEN HEMORRHAGE occurs in accidental wounds or in regions where the blood appears at the surface. In many cases of this type the source is inaccessible to surgical measures. Examples—stomach, lungs, intestine or uterus. The amount of blood which is lost is difficult to determine but is usually overestimated, since bleeding is always startling. Arterial hemorrhage may be rapidly fatal if not promptly controlled. However, moderate loss of blood is quickly compensated by the absorption of fluids from the tissues. The blood-forming organs overcome the resulting anæmia in a comparatively short time.

Repeated losses of blood, even though of moderate amounts (from uterine bleeding or hemorrhoids), cause serious anæmia which is not easily overcome. Bleeding may be (1) arterial; (2) venous; (3) capillary.

1. Arterial hemorrhage is characterized by a steady or pulsile flow, evidently under pressure, and is controlled only by clamping or ligating the artery or compression of the vessel higher in its course.

2. Venous hemorrhage is continuous, under less pressure than is the arterial form, and is more easily controlled by packing the wound. Injury to a large vein may cause rapidly fatal bleeding.

3. Capillary bleeding occurs in wounds, is rarely serious, being easily controlled by local pressure, packing the wound, or by sutures. Occasionally such bleeding may be persistent when occurring from highly vascular or inflamed surfaces. Example, mucosa of the nose and throat.

Treatment.—1. Control of bleeding: (a) Local measures have been considered in the care of accidental wounds. (b) Constitutional therapy to alter the composition of the blood and favor coagulation is necessary in certain cases, including transfusion of blood, injection of whole blood, blood-serum, or horse-serum, and calcium compounds by mouth.

2. Measures to overcome the loss of blood are usually applied after the bleeding has been controlled. Fluids are supplied to raise the blood-pressure and overcome the cerebral anæmia. Transfusion of blood is indicated in more serious cases, intravenous infusion of normal saline, hypodermoclysis, or proctoclysis in less urgent conditions. Stimulants and tonics are used later to increase the production of blood-cells and hæmoglobin.

B. Concealed hemorrhage may occur: 1. Into the tissues of the body and is usually self-limited by pressure and coagulation of the blood. It is more often the result of injury to a blood-vessel by fracture or dislocation, less often the spontaneous rupture of a diseased artery, "aneurism." There is pain due to distention of the tissues by the extravasated blood. If this reaches the surface there is "ecchymosis" or the "black and blue" mark due to the presence of blood-cells and pigment hæmoglobin in or under the skin. A hæmatoma, blood tumor,

is formed by the coagulation of the blood, and may be absorbed if not too extensive. In other cases the clot is liquefied, forming a fluid "hæmatocele." There is always danger of a hæmatoma or hæmatocele becoming infected, since it is composed of dead tissue and has low resistance to any bacteria which may reach it. Evacuation or aspiration under aseptic precautions is indicated in some cases.

2. Hemorrhage may take place into one of the hollow organs or one of the body cavities (pericardium, peritoneum). From some of the organs (stomach, intestine, or uterus) the blood eventually reaches the surface, but serious or fatal hemorrhage may previously have occurred, and the condition practically amounts to concealed hemorrhage. *Causes* of this type of bleeding are varied and include many medical or surgical lesions. Examples: Post-partum hemorrhage, extension of an ulcer of the stomach or intestine into a blood-vessel, pulmonary hemorrhage in tuberculosis, traumatic rupture of the liver or spleen, rupture of an ectopic pregnancy, spontaneous rupture of an aneurism. Conditions in the new-born causing delay in the coagulation time of the blood result in persistent bleeding from the mucous membranes. Family tendency in individuals who are spoken of as "bleeders," also in cases of persistent jaundice, where small wounds bleed persistently in spite of ordinary attempts to control.

Effects.—The special mechanical local effects of blood clots will be mentioned in connection with certain regions (brain). When hemorrhage occurs into a free cavity there is little or no pressure on the bleeding vessel and no tendency to spontaneous control of bleeding by coagulation as in the case of more solid tissues. Hemorrhage is likely to continue till the blood-pressure falls, when coagulation of blood may occlude the bleeding vessel. If the general blood-pressure is raised by stimulants before a reasonably solid clot has formed, the bleeding is likely to recur. General effects are similar to those associated with external hemorrhage, but the early symptoms are important in the recognition of the condition. There is (a) pallor; (b) rapid, irregular pulse (120 to 150) which becomes faint and irregular; (c) temperature, if previously elevated, falls to subnormal. There is a peculiar faintness, restlessness, shortness of breath, and finally unconsciousness from cerebral anæmia, and death,

The immediate effects of a single non-fatal hemorrhage are rapidly offset, but this is not true of repeated bleedings over a short period of time.

Treatment.—Local special surgical measures for the control of bleeding are indicated in certain conditions where there is reasonable hope of reaching the source. Examples, ectopic pregnancy, puerperal hemorrhage, or rupture of the liver or spleen.

General measures meet two indications: (*a*) to prevent recurrence, (*b*) to overcome the effects.

(*a*) To prevent recurrence: Absolute rest in bed, with the ice-bag locally. Morphine to prevent vomiting, peristalsis or cough, and also nervousness and restlessness. Therapy, to alter the composition of the blood and shorten the coagulation time, includes transfusion of blood, injection of whole blood, blood-serum, horse-serum or lime salts.

(*b*) Measures to overcome the effects of bleeding are usually reserved till this is controlled, since rise of blood-pressure may cause recurrence. These include transfusion, pituitrin, adrenalin with saline by hypodermoclysis or intravenously, stimulants and tonics.

Surgical Operations, Preparations, Aftercare, Complications, and Anæsthesia.—The term surgical operation as commonly used refers to any procedure which involves the cutting or suture of various structures. It really is a broader term than is usually understood, and includes many manipulations where there is no cutting. Examples: Reduction of fractures and dislocations, certain obstetrical procedures, forceps and version, procedures which require anæsthesia, may cause shock, or be complicated by sepsis.

MINOR OPERATIONS are those which produce little or no danger to life, or to serious complications. MAJOR OR CAPITAL OPERATIONS expose the patient to more or less risk of fatal outcome. The terms are somewhat relative, depending to a considerable degree upon the physical condition of the individual at the time of the operation.

A. INDICATIONS.—*Emergency operations* are those done for grave conditions where relief must be more or less immediate to prevent serious damage, or to save life. The urgency of the condition may be a matter of minutes, hours, or days. Ex-

amples: Obstruction of the trachea, demanding instant tracheotomy, ruptured gastric ulcer or gangrenous appendix with rapidly spreading peritonitis, strangulated hernia or intestinal obstruction, malignant new-growth.

Elective operations are those where the exact time is a matter of some choice and there is no serious danger of fatal or grave results by moderate delay. Examples: Removal of benign tumor, repair of hernia or obstetrical lacerations, correction of deformities, or certain plastic operations.

B. CONTRAINDICATIONS to operations include anything which renders the danger from the particular operation or its complications greater than that of the original condition. There may be: 1. Contraindication to general anæsthesia (see p. 68). 2. Serious shock in traumatic or emergency cases may require special treatment before the necessary operation can be done. 3. Certain constitutional conditions (diabetes, arteriosclerosis, some forms of kidney disease, advanced age, extreme malnutrition or cachexia, syphilis, tuberculosis or acute infections) are likely to interfere with wound healing or to predispose to serious complications.

C. PREPARATION OF THE PATIENT for operation includes many details which are left to the nurse in charge:

1. *Operations at home* may be unavoidable on account of extreme emergency, distance from the hospital, or condition of the patient. With ingenuity and attention to each detail, it is possible to provide for major operations in any modern home. In such cases the nurse in charge will usually have to arrange the details. The room should be as near the patient's bedroom as possible, and in many instances this room is used. The chief considerations are good light, ample room, and access to running water or a bathroom. Extra furniture is removed, the floors and walls wiped down with cloths moistened with antiseptic solution. In the absence of a regular operating table, a kitchen or dining table can be adapted. Extra stands, chairs, basins, and irrigators are provided. An ample supply of dressings, gauze, cotton, and apparatus are prepared, or obtained, freshly sterilized, from the hospital.

2. *The transportation* of a sick patient to the hospital will usually be directed by the physician, but the nurse must attend to the details. Sudden jarring or movement must be avoided

in many cases, because of pain, danger of rupture of a gangrenous
appendix, spread of peritonitis, or internal hemorrhage. Frac-
tures, dislocations, or severe injuries must be immobilized in a
temporary dressing. The patient is best made comfortable on
a cot or stretcher which can be placed in the ambulance. Plenty
of hot-water bottles, heaters, or blankets must be provided to
prevent chilling. Morphine may be ordered in certain cases to
relieve pain. If possible the nurse is to accompany the patient
to attend to emergencies in the ambulance.

3. *Preparation of the patient:* Various routine methods pre-
vail in different hospitals, and only general principles can be
discussed. (*a*) Mental preparation: It is of the utmost im-
portance that the patient approach the operation in a calm,
hopeful state of mind. To this end, all preparations are to be
made without unnecessary discomfort or excitement. The
entire atmosphere is that of calm assurance and quiet confidence.
Discussion of the patient's condition is to be avoided, also the
account of similar cases. Sleep, especially the night preceding
the operation, is most essential, and a hypnotic, such as veronal
or chloral, may be ordered for this purpose. The use of mor-
phine hypodermically in the morning is a matter for individual
judgment of the surgeon. In certain cases where it is necessary
to avoid the deleterious effects of apprehension and fear (exoph-
thalmic goitre) a special procedure is developed. The patient is
kept in the hospital for treatment, which includes suitable
sedatives, some of which are given hypodermically. She is not
informed as to the exact date of operation, but is prepared by
daily short inhalations of nitrous oxide. Finally she is given
the preliminary morphine, fully anæsthetized and transported
to the operating room, in this manner eliminating the psychic
element of fear. (*b*) Cleansing: A complete bath, either tub
or sponge, is customary preceding the preparation of the opera-
tive field. For the latter, special technics are in use in different
hospitals. Except in emergency cases, the preliminary prepara-
tion consists of either a scrub with gauze and green soap and
shaving, after which the field is covered with aseptic or in some
cases with a mildly antiseptic dressing, or the preliminary
cleansing is done with an iodine-benzine mixture followed by a
dry shave and aseptic dressing. Final preparation on the table
may include simply painting with 3 per cent. or 5 per cent.

tincture of iodine, or the use of special solutions, such as McDonald's solution:

Pyxol.......................... 1
Acetone....................... 40
Alcohol....................... 60

or similar mixture:

Liquor Cresolis Comp.......... 2
Acetone....................... 35
Alcohol, q.s.ad............... 100

(c) Diet and care of the bowels: The stomach and intestinal tract should be as nearly empty as possible, but not irritated by violent catharsis. At the same time the patient must not be starved, and surgeons are aware that injudicious restriction of food preceding operation may cause serious post-operative complications. For the day preceding operation, unless there be a special contraindication (peritonitis, etc.), the patient should receive a light, easily digestible diet, which will leave little residue. Unless there are special contraindications there is little objection to a hot drink, tea, black coffee, or malted milk, early in the morning, several hours preceding an anæsthetic. *Contraindications:* Threatened peritonitis, intestinal obstruction, or the probability of operation on the gastro-intestinal tract. *Gastric lavage* may be indicated preceding the anæsthetic or operation in case of excessive vomiting, with intestinal obstruction, or in emergency cases with a full stomach. The bowels, if previously well open, may require only a soapsuds enema. If possible, nothing should be given which will interfere with a good night's rest preceding the operation. An active cathartic is best given at least 36 hours previously, and the bowels moved by enema the night or morning immediately preceding the operation. Active or repeated catharsis leaves the tract in an irritated condition and is likely to cause post-operative distention, "gas pains," or even obstruction. *Cathartics are contraindicated* in cases which suggest peritonitis, acute appendicitis, or intestinal obstruction, unless especially ordered, and the bowels must be moved by enemas.

(d) Preparation for anæsthesia: The question of a preliminary hypodermic of morphine (gr. $\frac{1}{6}$ to gr. 1.4) with or without atropine (gr. $\frac{1}{150}$), is to be decided by the surgeon, preferably

for each patient. If properly used, this will do much to insure an easy anæsthetic. It should be given at least one-half hour before the patient goes to the operating room, and after all other preparations are complete so that there is no further disturbance. There must be ample protection from cold; a warm shirt or pad for the chest, the limbs well covered, and plenty of blankets or hot-water bottles. For all pelvic, abdominal, or vaginal operations, the patient must be catheterized or allowed to void urine immediately before the hypodermic is given, to be sure that the bladder is empty. The mouth should be cleansed with an alkaline antiseptic wash, and false teeth removed. The nurse usually accompanies the patient to the operating room and is expected to be familiar with the essential points on the chart, pulse, temperature, and general condition of the patient. She will usually remain until anæsthesia is complete, and in some instances throughout the operation. She should be informed of the nature and extent of the operation in order to understand the particular after-care, but in no instance to discuss with the patient or friends. The unvarying rule is that all inquiries are to be referred to the surgeon.

The care of the patient on the table is usually in charge of the operating room staff. It is important to avoid chilling; see that the chest and unexposed parts are well covered, and that artificial heat is used if necessary. The position must be as comfortable as possible, the arms supported preferably at the side, avoiding tight constrictions or an arm hanging over the side of the table. A pad or pillow under the back will often prevent relaxation under anæsthesia and severe post-operative backache. Proper lithotomy position with no constriction about the limbs will avoid severe pain and possibly a compression neuritis. With care and attention, the change to and from the "Trendelenberg position" may be made simply, with no delay or confusion. Assistance to the anæsthetist may be expected of the private nurse, including observation of the pulse, blood-pressure, or respiration; keeping the chart, giving hypodermics, hypodermoclysis, or proctoclysis.

D. AFTER-CARE AND POST-OPERATIVE COMPLICATIONS.— The dressings, drainage tubes, or bandages are attended to by the assistants or operating room nurse, but the private nurse is

usually responsible for returning the patient to the bedroom.
She must see that the patient is properly placed on the carriage,
that arms and limbs are well protected, that there are sufficient
blankets, and that there is no exposure. Constant attention
is necessary to prevent the aspiration of vomitus or mucus.
Above all, there must be no delay. The bed is previously
arranged, with the necessary pads, drawsheets, and hot-water
bottles, protected to prevent burns. The unconscious patient
is carefully moved and placed in bed.

1. *Dangers.*—(*a*) Injury to an arm, dislocation or paralysis,
by allowing it to lie under an unconscious patient. (*b*) Burns
from unprotected hot-water bottles or electric pads. (*c*) Aspira-
tions of vomitus or mucus. The nurse must be in constant
attendance till the patient is conscious and in good condition.

2. *Special Positions.*—(*a*) "Fowler's," imitates the sitting
posture and aims to secure the collection of fluid or pus in the
pelvis by means of gravity—to secure better drainage; to localize
the infection and prevent general peritonitis; and to keep septic
material from the upper peritoneum where absorption is more
rapid. (*b*) Position for shock, with the feet elevated. (*c*)
Bradford frame and special extension apparatus for fractures.

3. *Drainage* may be provided by means of: (*a*) Copious
gauze dressings to be changed frequently. (*b*) Gall-bladder,
by special tube pinned to the dressings. (*c*) Bladder, by a
tube sutured to the wound, and frequent irrigations, or a
retention catheter.

4. *Normal After-care.*—Unless otherwise ordered, the patient
is usually kept on her back, with the head low, for the first 12
to 24 hours, after which there is little objection to careful
turning from side to side, and a pillow. A back-rest is used
inside of a week, or earlier, in the aged. The time in bed varies
according to the nature of the operation and the condition of
the patient. The usual rule of about ten days represents a safe
minimum. It is important to avoid physical or mental over-
exertion and fatigue, which may easily be brought about by
too early rising or too many visitors, and result in discouraging
set-backs. The late convalescence is equally important, and
the patient must make haste slowly after leaving the hospital.
Even in the case of patients who have been previously well,
an elective major operation imposes a considerable burden. At

the least from two to four months should elapse before such a
patient is to be considered as absolutely well.

5. *Relief of Pain*.—A certain amount of discomfort is unavoid-
able, and when this is likely to be excessive the surgeon commonly
orders a hypodermic of morphine given as soon as consciousness
is regained. For the well-being of the patient, even minor dis-
comforts must be promptly relieved, for, if allowed to accumu-
late, the condition of the patient may become alarming. Per-
sistent or excessive pain may be due to: (*a*) Distention of the
wound caused by the formation of a hæmatoma, or the devel-
opment of local infection, and calls for examination by the
surgeon. (*b*) Intestinal distention and lack of peristalsis, "gas
pains," which are usually relieved by a high enema, either simple
soapsuds or with turpentine. Unless specially contraindicated
these may be given within the first 12 to 24 hours and repeated
as necessary. Persistent pain and distention suggest intestinal
obstruction, or, with fever, indicate peritonitis.

6. *Fluids and Feeding*.—In certain conditions such as severe
hemorrhage, shock, or prolonged operation, fluid may be rapidly
supplied by means of intravenous infusion, hypodermoclysis, or
proctoclysis. (*a*) Intravenous infusion is reserved for the more
extreme emergencies and is done by the surgeon. Normal saline
at about body temperature is used, and sterile instruments and
solutions should be readily accessible at all times. (*b*) Hypo-
dermoclysis, the slow injection of fluid, usually normal saline
at body temperature, into the loose, subcutaneous tissue of the
breast or abdomen (but *not* the back), is indicated in less urgent
conditions. (*c*) Proctoclysis, slow injection of fluid by the
rectum, supplies the body with water, prevents thirst, and
avoids the necessity of giving fluids by mouth when this is
contraindicated. It is used as a routine by some surgeons, and
when especially indicated by others. The fluid must be main-
tained at body temperature, given in a proper apparatus to
insure slow, regular administration and prevent discomfort or
expulsion of the fluid. Solutions used may be tap-water, normal
saline, glucose or sugar solution, or special formulas. A single
high enema, consisting of hot coffee or normal saline, to be
retained, is often ordered in case of shock.

Nutrient enemas, while of doubtful value for prolonged use,
are often ordered for a few days when feeding by the mouth is

impossible or contraindicated. Various formulas are given in texts on nursing methods. The mixture must not be irritating to the bowel. The volume must not be too large to be retained (four to six ounces), the rectum cleansed by saline irrigation, and the enema not repeated within from four to six hours.

7. *Care of the Wound.*—All dressings are usually done by the surgeon unless especially directed. Clean wounds are rarely dressed more than twice during the first ten days. Infected wounds will require more frequent change of dressings, some of which may be left to the nurse. For all dressings there is needed antiseptic solution, bichloride 1 to 1000, lysol ½ per cent. or sat. boric., sterile towels and dressings, bandage scissors, adhesive, fresh bandage and binder, sterile instruments, the patient in a comfortable position so that there may be no delay.

POST-OPERATIVE COMPLICATIONS include: (1) shock, (2) hemorrhage, (3) pain, (4) excessive vomiting, (5) retention of urine, (6) fever, infection or sepsis, (7) thrombosis, (8) pneumonia.

1. *Shock* is characterized by a sudden depression of certain vital centres which control the heart-beat and blood-pressure, and complicates serious painful injuries, burns and surgical operations, not infrequently being fatal.

Causes include several factors acting alone or in combination: (*a*) Painful sensory stimuli reaching the central nervous system, even under anæsthesia, from crushing injuries, burns, or continued operative manipulation of sensitive tissues. (*b*) Psychical stimuli (fright, apprehension, or fear) are said to have a similar depressing effect. (*c*) Hemorrhage, or sudden loss of blood, possibly by causing a fall in general blood-pressure. (*d*) Toxæmia from the anæsthetic—chloroform, or ether, and to a less degree, nitrous oxide.

Effects and Symptoms.—There is a depression of the central nervous system, possibly due to cerebral anæmia, with vasomotor disturbance, evident first by a fall in the blood-pressure. The onset is often sudden, with "syncope" or fainting, or may be preceded by restlessness and mental apprehension. During this time the pulse becomes rapid, thready, low tension and irregular. The blood-pressure falls, the heart becomes weak and death is imminent. Shock in traumatic conditions may present the most urgent indication for treatment, to a degree

that operative measures are postponed till this is overcome. The prognosis is difficult to determine, but depends on the prompt recognition of the condition and proper treatment.

Principles of Treatment.—(*a*) Prophylactic: Avoid painful manipulation of injuries and burns, and relieve pain with morphine. During operation, maintain regular, adequate anæsthesia, possibly reinforced with local anæsthesia. Manipulation of sensitive tissue is to be avoided as much as possible. Prompt recognition is essential and nothing done which will increase the irritability of the nervous system. On this basis, strychnine or similar stimulants are *contraindicated*. Quiet and rest is essential and is often best obtained with morphine. (*b*) Measures to restore the vasomotor balance are indicated. Diffusible stimulants, camphorated oil, caffeine, brandy or ether, may be ordered hypodermically. Normal saline, possibly with a few drops of 1 to 1000 adrenalin is used, intravenously, by hypodermoclysis or proctoclysis, depending on the urgency of the condition. Caffeine, in the form of hot coffee, given by the rectum is of great value.

2. *Post-operative Hemorrhage.*—(*a*) Open bleeding from the wound is evident in the dressing and calls for prompt attention by the surgeon. Moderate bleeding into a closed wound causes pain from the distention of the tissues and leads to the formation of a hæmatoma, with danger of local infection. (*b*) Concealed hemorrhage has been considered (see page 54). It is most likely to occur soon after the operation, but in some instances develops several days later due to local infection and sloughing. The condition is often confused with shock. The effects are restlessness, faintness, local distress, shortness of breath, rapid, weak, and irregular pulse. Such suggestive changes demand the prompt attention of the surgeon. In the meantime, absolute quiet, the ice-bag locally, and possibly morphine hypodermically is indicated.

3. *Excessive Pain.*—(*a*) In the wound (i) soon after the operation, is caused by hemorrhage and distention of the tissues. It calls for prompt examination by the surgeon, who may find it necessary to remove one or more sutures and evacuate the contents. Wet dressings of mild antiseptics are often used. (ii) Local pain several days later is usually due to wound infection and is accompanied by fever. It demands an examination

by the surgeon, and is evident by local redness, swelling, tenderness, and possibly fluctuation. Early attention is necessary to secure evacuation of septic material, to prevent extension and breaking down of the entire wound. It is then treated as an infected wound.

(b) General abdominal pains, "gas pains," due to intestinal distention, are frequent following operations where the peritoneum has been invaded, especially if there has been peritonitis. Persistent abdominal pain is also an early indication of developing peritonitis or intestinal obstruction, and requires careful attention. It is best relieved by high enemas of soapsuds with turpentine. Unless there is special contraindication (operations on the rectum or lower bowel), an enema may be given within the first 24 hours or as soon as pain is distressing, and repeated until flatus is passed freely. An ice-bag to the abdomen is of great value. Morphine is contraindicated unless specially ordered. Pituitrin hypodermically in small doses is used considerably.

4. *Nausea and vomiting* are common after general anæsthesia, particularly ether, during the first 24 hours, and may be prolonged by injudicious feeding. If proctoclysis is used, fluids by mouth can easily be withheld till nausea and vomiting cease. Fluids by mouth must be started carefully with sips of water or bits of ice and gradually increased with the addition of albumen water, milk diluted, or butter-milk, avoiding incompatible mixtures. Persistent nausea or vomiting calls for gastric lavage, which usually controls the situation.

Other causes for severe vomiting are (a) acute dilatation of the stomach, (b) intestinal obstruction, and (c) developing peritonitis.

(a) Acute dilatation of the stomach is caused by spastic contraction of the orifices, pylorus and œsophageal opening, with atonic dilation of the wall. The organ may reach tremendous size, cause evident distention of the abdomen, and embarrass respiration or the heart-beat. There is persistent nausea and attempts to vomit, which are usually unproductive but interfere with rest. If neglected, the condition may become fatal. Treatment: Prompt evacuation of the contents with stomach-tube, lavage with sodium bicarbonate solution, and in some cases a cathartic (castor-oil) is left in the stomach. The

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use of the tube may have to be repeated as the condition recurs.

(b) Intestinal obstruction is characterized by persistent vomiting, which eventually becomes fecal, abdominal pain, and distention.

(c) Peritonitis also causes continued nausea and vomiting, abdominal pain, elevation of temperature, and rapid pulse.

5. *Retention of urine* is not infrequent following operations and often necessitates the use of the catheter, which, however, is to be avoided if possible. *Causes*: (a) Lack of secretion of urine due to pathological changes in the kidneys, effects of the anæsthetic or operation, or lack of fluids in the body; (b) injury to the bladder or urethra, extreme distention of the bladder; (c) inability to use a bed-pan or urinal, nervousness.

Every effort is to be made to secure voluntary passage of urine before there is discomfort from over-distention of the bladder. Many patients are self-conscious, nervous, and not able to use a urinal or bed-pan readily. Much tact and judgment may be needed. A local douche or enema is valuable, and, when not contraindicated, it may be preferable to allow a semi-sitting posture. Frequently a single catheterization is all that is necessary, but too often it has to be repeated several times. *Objections:* The danger of infecting the bladder and causing "cystitis" is great when catheterization is repeated, no matter how carefully aseptic technic is followed. In using the catheter, it is necessary to have good light and free exposure in order that there may be no contamination of the sterile catheter by contact with the bedding or external parts.

6. *Fever* following operation for excision or drainage of a local inflammatory lesion indicates extension of the process, incomplete evacuation of the septic material, blocking of the drainage, remote pockets, or development of independent lesions in other parts of the body, and calls for the attention of the surgeon. Following clean operations there should be no elevation of temperature. Rarely there is a temporary rise to from 99° to 100° which can be said to be without significance. Any fever which persists for 24 hours must be explained, and the surgeon has to exclude infection in the wound, peritonitis, thrombosis, or some independent septic process.

7. *Thrombosis* is an occasional complication following from 5 to 15 days after abdominal and pelvic operations, especially when there is sepsis, less often after clean cases, or operations on remote parts of the body. It most frequently involves the saphenous or femoral vein, especially the left. It is associated with fever to 103°, pain in the groin, with painful swelling of the foot and leg. The duration is from one to two weeks. Complications are embolus, permanent partial occlusion of the vessel with varicose veins and recurrent swelling.

Treatment.—Rest in bed and immobilization of the limb as long as there is fever, tenderness or swelling, no massage to the limb, cotton flannel bandage with a soothing lotion or ointment (belladonna and mercury), and later a pressure bandage. A cradle is necessary to protect the limb from the pressure of the bedding.

8. *Bronchopneumonia* occurs as a serious post-operative condition in certain types of patients, especially the aged or those who are handicapped by severe malnutrition or cachexia. *Causes:* Aspiration of mucus or septic material from the mouth, prolonged immobilization in bed, which is favorable to hypostatic congestion of the lungs. Prophylaxis consists of (*a*) care of the mouth, attention to prevent the aspiration of vomitus or mucus while the patient is unconscious; (*b*) protection from exposure and chilling; and (*c*) aged patients, and those who are cachectic must not be kept on their back longer than necessary. The early use of the back-rest, turning from side to side, and measures to stimulate deep breathing, are indicated as early as possible.

Surgical anæsthesia includes various methods used to prevent pain caused by manipulating or cutting sensitive tissues. It may be (A) general, or (B) local.

A. GENERAL ANÆSTHESIA is induced by the inhalation of certain drugs, (1) chloroform, (2) ether, or (3) nitrous oxide, and produces unconsciousness to painful stimuli, with relaxation of the voluntary muscles. *Indications:* Dressings, manipulations, or operations which cause severe pain; dressing extensive burns or severe injuries; reduction of fractures or dislocations; extraction of teeth; minor and major surgical operations. *Contraindications* vary for special drugs (see later), but include

advanced age, certain heart lesions, pulmonary tuberculosis, marked kidney or arterial changes, cachexia, or severe malnutrition.   Such conditions must be considered by the surgeon, who will decide the question of local or general anæsthesia.

1. *Chloroform* induces prompt and complete anæsthesia and causes few post-operative effects.   It is rarely used on account of the following objections:

(*a*) The margin of safety between surgical anæsthesia and dangerous or fatal narcosis is exceedingly narrow.   (*b*) Sudden death on the operating table from certain reflex causes or profound narcrosis has occurred and is apparently unavoidable. (*c*) Pathological changes in the liver and kidneys have been demonstrated after repeated or prolonged chloroform anæsthesia.   (*d*) Late after-effects, vomiting and acidosis, may be fatal.

Chloroform should be administered only by an expert who is thoroughly conversant with every danger involved.   It is to be given on an open mask with a free supply of air in order to avoid sudden concentration of the vapor.

Ether is most generally used except in certain clinics where nitrous oxide is favored.   It produces complete anæsthesia and muscular relaxation, with a wide margin of safety.   The administration is simple, and there are few serious after-effects. Nausea and vomiting depend to a great extent upon the condition of the gastro-intestinal tract.   The stomach should be empty, the stomach-tube being used in certain cases.   Ether is said to be contraindicated in some forms of intestinal obstruction, also bronchitis, severe asthma or pulmonary tuberculosis, advanced age or extreme cachexia.

This anæsthetic is commonly administered on a thick mask well surrounded by moist towels and is dropped from the container.   Anæsthesia is begun slowly with an open mask allowing a free supply of air.   Towels are added about the mask as the anæsthesia is deepened.   From ten to fifteen minutes are required to secure complete relaxation.   The administration of morphine sulphate gr. $\frac{1}{6}$ with atropine gr. $\frac{1}{150}$, one half hour preceding, renders the process more simple.   A number of special masks and more or less complicated forms of apparatus have been devised and are popular in certain institutions. For operations about the head or throat, the pharyngeal or larygeal method of giving warmed ether vapor by means of

special atomizers is of distinct advantage.   In many clinics nitrous oxide with oxygen is used to induce preliminary anæsthesia and warm ether vapor is given to continue the process.   Certain professional anæsthetists have attained marked success by giving ether in oil by high rectal tube. Special advantages are claimed for this method, particularly for operations about the head or mouth.

3. *Nitrous-oxide gas* is kept in iron tanks under pressure and given with a special apparatus, usually in combination with oxygen.   Extensive experience is required, and the gas should be administered only by an expert.   It induces prompt and complete anæsthesia, causes less shock, and is followed by no special after-effects.   It is considered by many to be the anæs-thetic of choice, especially in doubtful cases.

In some operating rooms nitrous oxide with oxygen is used as a routine to induce anæsthesia for short operations or is combined with ether for long procedures.

B. LOCAL AND REGIONAL ANÆSTHESIA include (1) infil-tration anæsthesia. (2) regional anæsthesia, and   (3) spinal anæsthesia.

It is induced by the subcutaneous injection of anæsthetic drugs. Cocaine in $\frac{1}{2}$ per cent. to $\frac{1}{6}$ per cent. solution, which is objected to on account of not infrequent toxic effects, and because solutions cannot be boiled.

Novocain in $\frac{1}{2}$ per cent. to $\frac{1}{10}$ per cent. solutions is said to be non-toxic, and is not deteriorated by boiling. It is made up in normal salt solution, often with the addition of a few drops of adrenalin 1 to 1000 to the ounce of mixture.

A number of cocaine derivities and synthetic compounds are on the market and present many advantages over cocaine.

Urea hydrochloride in 1 per cent. to $\frac{1}{4}$ per cent. is also used for local anæsthesia.

Indications: Minor operations, enucleation of superficial tumors, repair of hernia in the adult, and many major operations where general anæsthesia is contraindicated.   Also it is often used in conjunction with general anæsthesia to avoid shock.

1. *Infiltration anæsthesia* is induced by injecting the solution into the skin and subsequently into each tissue layer as it is exposed.

2. *Regional Anæsthesia.*—The area of operation is blocked off by deep injection of the solution into the surrounding tissues,

and in some cases the sensory nerves are exposed and directly injected.

3. *Spinal Anæsthesia.* —The anæsthestic agent of which a number are in common use is dissolved in proper solution and injected by lumbar puncture directly into the subarachnoid space of the spinal canal. In about a half an hour, this permits of major abdominal or pelvic operations. The method may be selected for certain handicapped patients, for whom a general anæsthetic would be hazardous. Similar results for pelvic, perineal operations or those on the lower extremities may be more safely attained by injecting the solution into the sacral canal. However, either method presents danger of serious or fatal complications and should be used only by experts.

DEMONSTRATIONS

1. Types of accidental wounds.
2. Condition of clean wound at closure and at first dressing.
3. Stitch-abscess.
4. Demonstration of Carrel-Dakin apparatus.
5. Method of preparing an accidental wound for surgical care.
6. Method and precautions in the use of a tourniquet.
7. Application of a pressure bandage to control hemorrhage.
8. Study of case histories cases of severe hemorrhage and recovery.
9. Assembling material and apparatus for operation in private house.
10. Method of placing patient on stretcher and transporting from bed to ambulance,[arrangements of bottles, blankets or special splints.
11. Methods of preparation for operation,and for transporting to operating room, also arrangement of patient on the table.
12. Mechanism of operating table, change of position, etc.
13. Assembling and preparation of apparatus for intravenous infusion, hyperdermoclysis, and gastric lavage.
14. Charts and methods of recording blood-pressure on the table.
15. Preparation of the bed for return of patient, with special positions, and apparatus for drainage.
16. Methods of giving enemas, insertion of high rectal tube and proctoclysis.
17. Position and methods of treatment of shock.
18. Preparation for and method of catheterization.
19. Tray and necessary supplies for dressing.
20. Technic of clean dressing.
21. Care of " milk-leg."
22. Preparation of ether mask and anæsthetist's table.
23. Special apparatus for anæsthesia, ether and nitrous oxide.
24. Local anæsthesia, apparatus, and preparations.

CHAPTER VI

BONES AND ARTICULATIONS

BONES: STRUCTURE, INFECTIONS, TUMORS, INJURIES

A. **Structure:**—On this basis bones are classified in three groups: (1) long bones, (2) flat bones, and (3) irregular bones.

1. LONG BONES (Fig. 8) (example, femur or humerus) consist of a shaft ("diaphysis") and two enlarged extremities ("epiphy-

ses"). The development of the bone is characteristic, with a principal "centre of ossification" for the shaft or diaphysis, and one or more "secondary centres" for each extremity, or epiphysis. During development each epiphysis is separated from the diaphysis by a layer of special hyaline cartilage, the "epiphyseal cartilage" in which new bone is formed and growth in length takes place. This relation of the epiphyseal cartilage to the epiphysis and diaphysis persists throughout childhood, and firm bony union occurs in various bones between the ages of sixteen and twenty-four, after which growth in length ceases. The development of the epiphyseal cartilage is significant from a practical standpoint for the following reasons:

FIG. 8.—Long bone, humerus.

(a) Growth in length of the bone occurs only in the region of the epiphyseal cartilage, and ceases if this be destroyed by injury, separation, disease, or operation.

(b) Traumatic separation at this point occurs in childhood, resembling fracture.
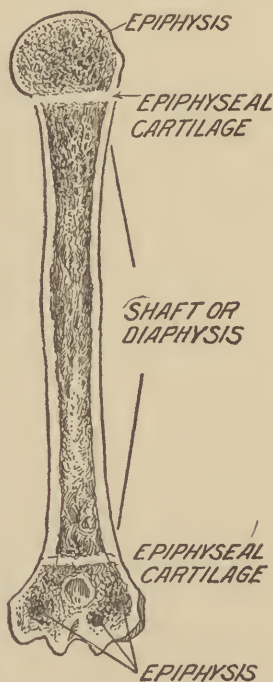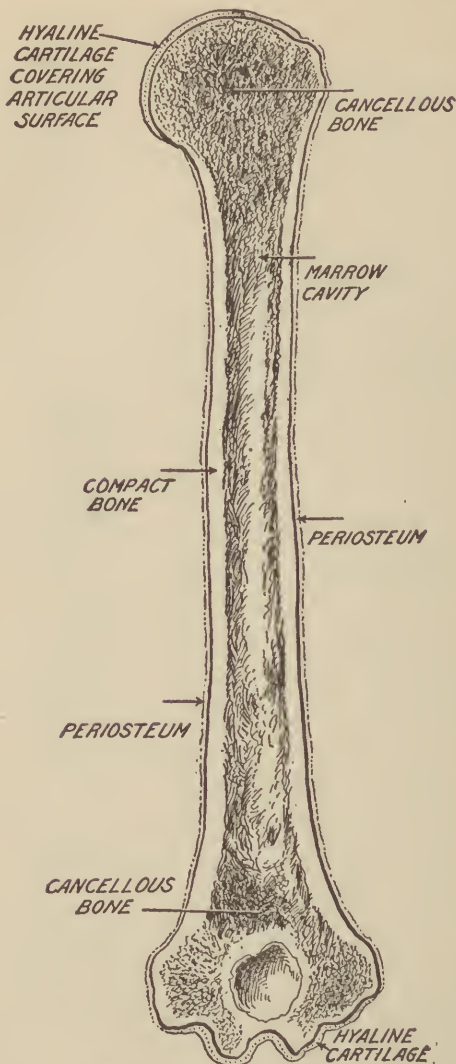
Fig. 9.—Longitudinal section of bone, showing structure.

(c) In a Röntgen ray examination, the secondary centres of ossification appear as distinct fragments of bone and may be confused with a displaced fracture.

(d) The blood supply of the epiphyseal portion is independent from that of the diaphysis. Therefore certain types of infection are more frequently found in one portion and tend to remain independent of the other.

2. FLAT BONES include the scapula, parts of the pelvis, and the cranium. They develop in two plates from layers of fibrous tissue, and are therefore called "membrane" bones. They consist of two bony plates of compact structure separated by an intervening layer of cancellous bone and marrow.

3. IRREGULAR BONES include the vertebræ and carpal and tarsal bones. They consist of masses of cancellous bones which are rather compact on the surface.

The structure of bone is best studied in a longitudinal section of a long bone, in which the following parts call for attention (Fig. 9): (a) the periosteum; (b) the compact outer portion; (c) cancellous bone; (d) the marrow cavity.

(a) The *periosteum*, composed of dense fibrous tissue with an exceedingly rich vascular supply, surrounds the entire bone except for the articular surface, which is covered with hyaline cartilage. This layer carries the most important blood-supply to the compact bone and determines its nutrition, also supplies a layer of underlying "*osteoblasts*," the bone-forming cells which produce new bone in early development and, to a greater or less extent, throughout life. The relations of the periosteum are of practical importance: (i) On account of its density, subperiosteal swellings (blood or pus) are retained and cause severe pain. (ii) Separation of the periosteum from the underlying bone by blood, pus, or injury interferes with the nutrition of the bone and often causes necrosis. (iii) Considerable portions of a bone may be destroyed by disease or removed by operation, but if the periosteum with the underlying osteoblasts is preserved, regeneration of bone takes place to the extent that an entire structure may be replaced.

(b) The *compact outer bony part* lies immediately under the periosteum, represents the source of its greatest strength, and is the most recently developed part of the bone.

(c) *Cancellous structure* is present to a greater or less extent in all bones, and contains interspaces of varying size in which are found vessels, nerves, and bone-marrow.

(d) The *marrow cavity* forms a definite space in all long bones and contains nutrient vessels, nerves, fat, and certain blood-forming cells, composing the marrow.

B. **Infectious lesions** of bone, "osteitis," occur, as in other tissues, from wounds, compound fracture, or following remote septic processes in other parts of the body. Examples: Scarlet fever, tonsillitis, or unrecognized lesions. The process may be acute or chronic. In either condition the infection may occur as "osteomyelitis" or "periostitis."

1. OSTEOMYELITIS refers particularly to an inflammatory process which involves chiefly the marrow cavity and the central part of the bone. Effects: Constitutionally there is fever and evidence of sepsis, often severe. Locally, there is pain and tenderness, with swelling when the process is advanced. The infection may be obscure and recognition of the true condition is frequently difficult. It is often mistaken for one of the continued fevers—typhoid or rheumatism.

Local results: (a) Destruction of bone and the production of an abscess cavity in the shaft of the bone. (b) Considerable masses of necrotic bone slough into the abscess cavity, forming a "sequestrum." (c) A sinus is formed by spontaneous rupture to the surface or by surgical incision, and will persist till all necrotic material, sequestrum, is removed and the cavity is entirely filled. (d) The periosteum, with the layers of osteoblasts which surround the suppurating area, develop new bone, forming the *involucrum*, but healing is never completed till the sequestrum and all septic material has been evacuated. (e) Osteomyelitis in the region of the epiphysis, occurring in childhood, causes destruction of the epiphyseal cartilage, resulting in permanent shortening.

The course except in occasional virulent infections tends to be rather subacute, and sinuses may persist for years, being kept open by the presence of a necrotic sequestrum with a purulent discharge. Indications for surgical treatment, *i.e.*, incision and evacuation of necrotic material, are: (a) To evacuate pus and septic material and relieve constitutional effects, toxæmia. (b) To prevent further destruction of healthy bone, especially when the process is in the region of the epiphyseal cartilage. (c) To remove a sequestrum and necrotic material and secure closure of a sinus.

2. PERIOSTITIS refers to an inflammatory lesion of the perios-
teum and underlying compact bone. It is often associated with
local injury as a causal factor. There are the usual constitutional
effects of sepsis. Locally there is swelling which is painful on
account of the dense periosteum, and recognition of the nature
of the condition is rather easier than is the case of deep-seated
lesions. The periosteum is separated from the underlying bone
by a collection of purulent material which leads to necrosis,
and spontaneous rupture to the surface may occur. Indications
for surgical treatment, *i.e.*, incision and evacuation of septic
contents, are the same as for osteomyelitis.

CHRONIC infections of bone include two types, tubercular
and syphilitic.

(a) TUBERCULAR lesions occur most often in children and
young adults. They are caused by the tubercle bacillus derived
from other lesions within the body, which, however, may be
remote, and the bony lesion may represent the only active
process. The focus most often involves the epiphysis of the
long bones and tends to extend to the adjacent joint. Consti-
tutional effects are those of tuberculosis and are important aids
in reaching a diagnosis. Results are: (i) Destruction of bone
and epiphyseal cartilage, with deformity and shortening of the
bone. (ii) Destruction of articular surfaces and "ankylosis"
or fixation of the joint, produced by the fusion of the articular
surfaces. (iii) Development of an abscess from which a sinus
may be produced by spontaneous rupture or surgical incision,
followed by secondary infection by other organisms. The irreg-
ular bones, carpals, tarsals and vertebræ, are also frequently
involved in tubercular processes.

"*Pott's disease*," tuberculosis of the vertebral column, occurs
more often in children but is occasionally found in adults. The
causes and constitutional results are the same as those of surgi-
cal tuberculosis in other parts. Results are: (i) Destruction
of the vertebræ with marked deformity of the spine, "kyphosis"
or "lordosis." (ii) Pressure on the spinal cord as a result of de-
formity of the body of the vertebræ, or inflammatory thickening.
(iii) Occasionally, the development of tubercular meningitis.
(iv) Formation of abscesses in neighboring tissues: (1) Retro-
pharyngeal cellulitis presenting in the throat from the cervical
vertebræ. (2) "Psoas" abscess from the lumbar vertebræ

extends in the sheath of the psoas muscle and tends to point about Poupart's ligament.

Evidences of tubercular disease: (a) General reaction of tuberculosis; irregular fever, night sweats, loss of weight, weakness, and reaction to diagnostic doses of tuberculin. (b) Local: (i) Pain in the region involved, also referred pain due to pressure on nerve trunks. (ii) Muscle spasm and limitation of motion, thus preventing irritation of the inflamed articular surfaces. (iii) Night pains and crying, caused by the relaxation of the protective muscle spasm during sleep. (iv) Deformity due to destruction of bone.

The early history of bone tuberculosis is usually obscure. The child is often well nourished and constitutional disease is not suspected. Local symptoms at first may be inconstant and slight, consisting only of pain and some limitation of motion. Examination will usually show some deformity. It is essential that such suspicious cases be brought to the surgeon at once to secure early diagnosis and cure with a minimum of deformity.

Treatment.—(a) Constitutional measures are indicated as in other tuberculous processes, and must be followed up till there is no evidence of the disease. (b) Local treatment is usually conservative, the general principle being complete and prolonged immobilization of the affected parts by means of plaster of paris cast, or special apparatus. This prevents irritation of inflamed tissues and promotes healing. Surgical measures, excision of foci of infection or evacuation of abscesses, are reserved for special cases and indications: (i) When the epiphyseal cartilage is involved or threatened, to prevent permanent shortening. (ii) In certain cases in adults according to the judgment of the surgeon. (iii) Under special conditions a collection of purulent material may advantageously be evacuated. Drainage is rarely used on account of the probability of secondary infection and the development of a persistent sinus. Occasionally the cavity is filled with antiseptic mixtures— iodoform oil, formalin in glycerin, or bismuth paste.

(b) SYPHILITIC periostitis consists of a gumma or a round cell infiltration of the sub-periosteal tissues; suppuration is rare except when due to infection following exploratory incision. There is severe local pain which is characteristically worse at night, local swelling, tenderness, and often evidence of syphilis

in other parts of the body. The specific tests are usually positive. Treatment is constitutional. The practical significance lies in the fact that these lesions may be mistaken for suppurating periostitis, and so treated.

C. **Tumors of Bone.**—There are two main groups of bone tumors: (1) Those which are *primary* in the bone, and (2) *metastatic* tumors which are secondary to malignant new-growths in other regions of the body.

PRIMARY bone tumors include those derived from supporting tissues. (a) Osteoma or exostosis, a hard, ivory-like, slowly developing process, is non-malignant. (b) Combinations of bone and cartilage or connective tissue, tumors which are characterized by more or less bone-destruction, are somewhat elastic, and often degenerate, forming cysts in the bones. Such tumors are usually non-malignant. (c) Various types of sarcomas, including the giant-cell sarcoma, which is slowly malignant, and the small round-cell sarcoma, and those derived from the lymph and blood-forming tissues, the endothelioma, all of which are highly malignant.

The presence of new-growth is made evident by local pain, swelling, and sometimes by spontaneous fracture when there is considerable destruction of bone, and by Röntgen ray examination. The exact nature of the tumor and its degree of malignancy may be determined to a certain extent by the rapidity of its growth, the X-ray picture, gross appearance on exploratory incision, or microscopic examination of the tissue.

Principles of Treatment.—For the benign tumors or those which are of low malignancy, excision of the tumor with a wide margin of normal tissue may be sufficient. For malignant sarcomas, amputation well above the level of growth is indicated at the earliest possible time, but recurrence is not infrequent. Metastases are rarely present. Certain non-operative methods are sometimes used for advanced *inoperable* growths, and sometimes delay the progress or occasionally result in cure.

2. *Metastatic* tumors in bone are always secondary to some type of new-growths in other parts of the body. They may be carcinoma or, less often, sarcoma. Metastatic new-growths are usually multiple, involving several bones in various parts of the body. They may be discovered accidentally as in case of "spontaneous fracture." The presence of several new-growths

in bone is evidence of metastases, and that the original tumor is inoperable. There is no curative treatment; palliative measures and careful nursing is all that is possible.

D. Fractures.—A fracture is a break in the continuity of bones, usually the result of violence, which may be (1) direct, at the site of the fracture, or (2) indirect, throwing the breaking strain at a point remote from the application of violence.

Predisposing causes which influence the type and frequency of fracture include: (a) Age. The bones are more elastic in childhood, and incomplete fractures, *infractions* or "green-stick fractures," are more common.

(b) The composition of bone is influenced by certain constitutional diseases, cretinism, myxodema, rickets, and a few rare conditions.

Fractures may be either (1) *open* or *compound;* or (2) *closed* or *simple, i.e.,* with no open wound, which is the type referred to unless otherwise specified.

1. OPEN or COMPOUND FRACTURES are those associated with a wound of the overlying skin or mucous membrane. The open wound may be produced: (a) By the violence which caused the fracture. (b) By a splinter of bone being driven through the surface. The principal dangers of a compound fracture are infection from the surface, sepsis, necrosis of bone, and imperfect union.

2. CLOSED FRACTURES are classified according to the nature of the break:

(a) *Incomplete "green-stick fractures"* or *infractions* occur most often in children, whose bones are more elastic and not brittle. There is deformity, local pain and tenderness, and ecchymosis, but no separation of fragments or abnormal mobility.

(b) *Complete fractures* may be oblique or transverse across the bone. There is lateral or antero-posterior displacement of fragments, and often injury to neighboring soft parts. There is deformity and abnormal mobility (Fig. 10).

(c) *Spiral fractures* occur along lines of cleavage in certain long bones due to twisting. For example, falling with the foot fixed may cause a spiral fracture of the femur, tibia, or fibula. The condition may be obscure and treatment is difficult.

(d) A *comminuted fracture* has several fragments of bone and

is usually the result of a crushing injury. There is considerable displacement, deformity, and abnormal mobility (Fig. 16).

(e) An *impacted fracture* is one in which the fragments are forced together by the violence which caused the fracture. There may be deformity but no abnormal mobility.

ASSOCIATED INJURIES to neighboring structures often occur from the violence which caused the fracture or by displaced fragments of bone.

(a) *Dislocation* of adjacent joints which may be mistaken for a fracture.

(b) *Muscles* or their tendons are often torn and may be interposed between fragments of bone, thus interfering with apposition and proper healing.

(c) *Blood-vessels*, especially veins, are frequently lacerated, causing the accumulation of a "hæmatoma," and later a deposit of blood near the surface, "ecchymosis," the presence of which is always suggestive of fracture.

(d) *Nerve trunks* are rarely lacerated, but are often stretched so that fibres are torn, resulting in temporary disturbance in sensation or weakness of certain muscles. Nerve trunks are occasionally exposed to pressure of bony fragments or callus formation, resulting in permanent disturbance for which operative treatment may be necessary.

EVIDENCES of the presence of fracture are:

(a) *Pain.* (i) *Local pain* is constant till the deformity is reduced and the fragments are immobilized. Further persistence of local pain indicates imperfect reduction, or immobilization, or undue pressure from dressings. (ii) *Tenderness* or acute pain on pressure, if persistent and definitely localized, is extremely suggestive of fracture or infraction.

(b) *Ecchymosis*, which appears within a few days of injury, is evidence of damage to deep structures, especially fracture.

(c) *Blood-vessels*, especially veins are often lacerated, causing the accumulation of an "hematoma," and later a deposit of blood near the surface, "ecchymosis" the presence of which is always suggestive of fracture.

(d) *Crepitus*, which is produced by friction of fresh bony surfaces, may be felt and heard, and is characteristic, if present. It is absent in incomplete and impacted fractures, also in those where there is considerable separation of fragments or inter-

position of soft parts.   Attempts to demonstrate crepitus are painful, and may do serious damage to soft parts, or break up a favorable impaction.

(e) *Abnormal mobility* is absent in infractions and impacted fractures.   It causes pain and there is danger of doing further damage to surrounding structures.   Often it can be demonstrated only under full anæsthesia.

(f) *Röntgen ray* plates properly taken, demonstrate accurately, the position of fragments before and after reduction.   Exposures from various angles are often necessary in doubtful instances.

(g) Examination under surgical anæsthesia is of value in many cases, but is done only when the surgeon is prepared to reduce the fracture and to immobilize it in a permanent dressing. There is serious danger of causing further damage by vigorous manipulations which are possible under anæsthesia.

PROCESS OF HEALING.—Provided the fragments of the fractured bone are in apposition and immobilized, healing occurs in three stages: (a) A serous or bloody exudate is poured out about the fracture as in wounds. (b) Bone cells develop from the fractured ends of the bone, forming the *callus* which surrounds the area of the fracture as a spindle shaped enlargement. This is visible as a light shadow in a Röntgen ray plate. (c) There is development of true bone giving firm union, and absorption of the excessive callus. If apposition and immobilization have been good there remains little or no deformity or evidence of previous fracture. The time required for complete healing varies for different bones. It increases with advancing age, when bone formation is less rapid. Fairly firm union is usually present in from two to six weeks in children and from four to twelve weeks in adults. However, at least double this time is necessary before a broken bone will stand weight-bearing, or a violent strain.

PRINCIPLES OF TREATMENT.—*Closed fractures:* First aid should provide immobilization to relieve pain and prevent further damage. Some form of a pillow or well padded splint can be secured in any surroundings, and will suffice for a few hours till permanent dressings can be provided.

THE AIM OF TREATMENT is to secure firm bony union and normal function without deformity. The *requisites* are: (1) Reduction, the correction of deformity and bringing the bony

fragments into accurate normal apposition without intervention of soft parts. (2) Immobilization of the fragments in apposition till firm bony union has taken place.

(1) *Reduction* usually requires full surgical anæsthesia, (*a*) on account of pain, and (*b*) to secure relaxation of voluntary muscles, though occasionally simple cases with slight deformity may be reduced without. Apparatus or dressings for immobilization are applied at once after reduction to maintain the corrected position. In case of doubt, the results of reduction are checked by X-ray pictures, thus disclosing any displacement, which may be corrected without delay. In some cases where there is extensive swelling, temporary immobilization is maintained for a few days and later readjusted.   Reduction and immobilization is impossible in certain cases of extreme displacement or on account of interposition of soft parts, and in some cases the corrected position can not be maintained.   (2) *Immobilization* is maintained by various types of rigid dressing: (*a*) Plaster of paris casts or moulded plaster dressing; (*b*) wooden or metal splints, padded, and held in place by adhesive plaster or bandage; (*c*) special apparatus designed to maintain constant counter-extension in certain fractures.   Each form has particular advantages or disadvantages in individual cases. Various surgeons have preferences for a particular style of dressing in special fractures and will select the form indicated in each instance. All of the necessary material must be on hand and ready before reduction is begun in order that no time be lost while the patient is anæsthetized.   Several strong assistants are needed to aid in reducing the fracture and maintaining the corrected position till the support is in place and set. A satisfactory dressing should hold the parts immobilized in accurate apposition, and there should be no severe pain after the first few hours.   Excessive swelling causes pain, but this should decrease after the fracture is successfully reduced and put up.   In some cases where there is excessive swelling, temporary well-padded dressings are applied and readjusted as the swelling subsides.   If a plaster cast is used, it may be split and held with adhesive strips to allow for swelling.

Excessive or *persistent pain* indicates undue pressure from dressings and should have the attention of the surgeon. Hypnotics must be used with care since the pain is an important

6

indication of serious pressure. This may (a) interfere with the blood supply or the venous return from dependent parts, indicated by congestive swelling and evidence of poor circulation in distal parts, *i.e.*, fingers or toes; (b) cause pressure on nerve trunks, resulting in pain and later paralysis or disturbance in sensation. Such symptoms are an indication for a readjustment of the dressings by the surgeon, who is the *only person* to interfere with them, since there is always danger of loss of apposition, and a poor result. As soon as firm union is definitely established, change of dressings, massage, or passive motion, under direction of the surgeon, may be indicated, especially in adults, to prevent stiffening of immobilized joints and tendons, and to hasten return of function.

OPEN, COMPOUND FRACTURES, are complicated by accidental, probably infected, wounds. In addition to treatment of the fracture, the open wound calls for suitable antiseptic care—control of hemorrhage, removal of foreign or necrotic material, and drainage. Provision must be made in the cast or apparatus for access to the superficial wound.

Open treatment of fractures consists of exposure of the fracture by surgical incision, adjustment of the fragments under direct vision, and the use of special means of immobilization. The latter may be accomplished by (a) metal screws, nails, or plates fastened to the bone, or (b) bone splints obtained either from the same patient, or those specially prepared and preserved. Such operations call for (a) the most absolute and rigid aseptic technique, (b) special and often complicated apparatus, and (c) extensive experience on the part of the surgeon in this particular work, and should be undertaken only when these requisites can be met. Open treatment may be indicated: (i) When reduction under anæsthesia is for any reason not possible. (ii) When immobilization in apposition cannot be maintained. (iii) In late cases when closed treatment has given bad results. (iv) In certain special fractures, experience has shown that good results are rarely obtained by ordinary methods, and open treatment is that of first choice. Example: Fracture of the patella.

Results of treatment: (a) A perfect anatomical result is the ideal. There is no deformity or shortening, the X-ray shows a normal outline of bone, and there is perfect function. (b) A

perfect functional result may show slight deformity or anatomical imperfection, but is acceptable if function is normal.

FAILURES OR BAD RESULTS.—(1) *Non-union* or *false joint*, with abnormal mobility may be due to: (*a*) Failure to secure apposition on account of extreme displacement or interposition of soft parts. (*b*) Imperfect immobilization. (*c*) Sepsis and necrosis of bone. (*d*) Local disease or new-growths. (*e*) Constitutional disease, rickets, myxodema, or conditions causing defective new-bone formation. Such results may call for open treatment or specific medication.

(2) *Excessive deformity* may be caused by incomplete reduction, or loss of apposition by imperfect immobilization, or excessive callus production. If this is demonstrated soon after being put up, it can often be corrected; otherwise open treatment may be demanded.

(3) *Persistent pain*, paralysis, or atrophy may be due to: (*a*) Injury to the nerve at the time of fracture or by subsequent manipulation. (*b*) Compression of a nerve trunk by tight dressing. (*c*) Pressure or involvement of the nerve in the healing of a fracture or callus production. Minor injuries to a nerve are followed by temporary disturbances in sensation or muscular weakness, which improve with rest, massage, and electric treatment. If the nerve-trunk is torn, or its continuity broken, suitable operation is necessary to restore function.

(4) *Injury to Blood-vessels.*—A local hæmatoma from laceration of a vein, less often from an artery, causes severe pain and swelling, and may predispose to local sepsis. The principal artery to an extremity (brachial in the arm) may be compressed by a tight dressing and cause gangrene or atrophy of dependent parts, or contraction of tendons or muscles, with serious deformity. *Warnings:* Severe pain or premonitory signs of deficient circulation call for prompt readjustment of the dressings.

(5) *Infection and sepsis* is frequent in compound fractures, and is an important complication following operative treatment. It occurs rarely, in closed comminuted fractures, with extensive injury to soft parts, hæmatoma formation, or the presence of necrotic tissue with deficient circulation.

(6) *Stiffness* and loss of function is more frequent in adults or those of advanced age, due to prolonged immobilization of joints and tendons.

Special Fractures.—Those of the face, head, vertebral column, and thorax will be considered in connection with those regions. A few of the important points will be mentioned concerning some of the more common fractures.

UPPER EXTREMITY.—*The clavicle* is most often fractured in the middle third by indirect violence, a fall on the shoulder. The deformity is characteristic, the shoulder drops forward and is rotated inward. It is corrected by being drawn upward and

FIG. 10.—Showing spiral fracture of the humerus with displacement.

FIG. 11.—Showing fracture of internal condyle of humerus.

outward, being held in the corrected position by adhesive straps. Fracture of the scapula is rare except from crushing injury or gunshot wounds. *Humerus* (Figs. 10, 11 and 12).— Fractures are classified as those of the (1) upper third, (2) middle third, and (3) lower third and condyles.

(1) The upper third includes the head, anatomical neck, and the "surgical neck," so-called because it is the most common site of fracture in this region. Fractures of the upper third

are difficult to immobilize in correct position. There is often injury to the circumflex nerve and paralysis of the deltoid muscle, with inability to raise the arm.

(2) Fractures of the middle third are often oblique or spiral, with considerable displacement of fragments. There may be involvement of the "radial" or "musculo-spiral nerve," with paralysis of the extensor muscles of the forearm or hand, and characteristic "wrist-drop."

Fig. 12.—Showing spiral fracture of humerus.

Fig. 13.—Showing fracture of both bones of forearm resulting from "direct violence."

(3) Fractures of the lower third: (a) Above the condyles displacement is usually antero-posterior, and immobilization may be difficult. (b) Those of the condyles and elbow are difficult to confirm without the X-ray, and immobilization is often unsatisfactory without open treatment. Involvement of the ulnar nerve may complicate and cause paralysis.

Forearm.—Fractures of the radius or ulna, or of both bones in the upper or middle thirds (Fig. 13), occur most often from

direct violence or from bending.   They require accurate appo-
sition and perfect immobilization, without crowding the bones
together, since there is danger of fusion of the two bones and
loss of function.   Fracture of the lower third is most frequently
the "Colles's" fracture, which involves the lower end of the
radius and at times the tip of the ulna.

Wrist and Hand.—Fractures of the carpal bones are obscure,
even with good X-ray plates. If overlooked or improperly treated,
these often result in permanent deformity.   Fractures of the

Fig. 14.—Showing fracture of the neck of the femur.

metacarpals and phalanges are often overlooked without X-ray
examination, being of the "green-stick" variety.

Pelvis and Lower Extremity.—Fractures of the pelvis result
from crushing injury, or rarely, difficult obstetrical delivery.
They usually occur lateral to the symphyses pubes and the
most common associated injury is laceration of the bladder or
urethra, with extravasation of urine into the tissues.   There
is mobility of fragments and severe pain in walking or movement.
Fixation of fragments is secured by tight bandage or open

operation. Repair of associated injury may present the most urgent indication.

Femur.—Fracture of the neck occurs most often during adult life or advanced age (Fig. 14). Reduction and immobilization in apposition is difficult, open operation being occasionally necessary. There is danger of non-union and permanent disability. Prolonged immobilization in a special cast or apparatus,
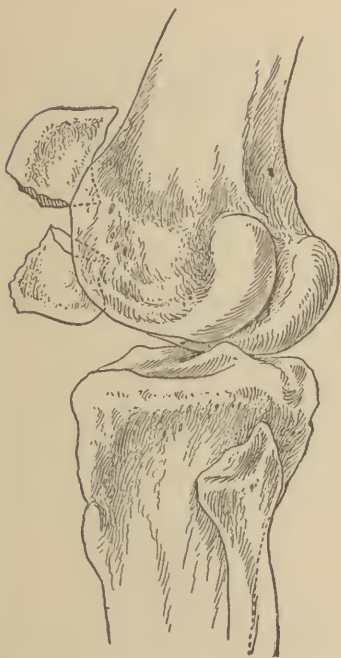
FIG. 15.—Showing fracture of the patella.   FIG. 16.—Showing "comminuted fracture" of the tibia.

usually in bed, carries serious danger of hypostatic pneumonia, especially in the aged. Fractures of the shaft of the femur are often oblique, spiral, or splintered, with marked displacement. They are difficult to reduce and require special apparatus for counter-extension, to overcome muscle resistance and to prevent shortening.

The *Patella or "Knee-cap"* is fractured by direct violence

(Fig. 15), blows or falling. It is practically impossible to maintain fixation of fragments without open operation, which is the method of first choice.

Leg.—The tibia or fibula is fractured by crushing injury (Figs. 16, 17 and 18) or by falling with the foot fixed, and is frequently compound. Accurate alignment and apposition are essential. Poor results often occur from too early weight-
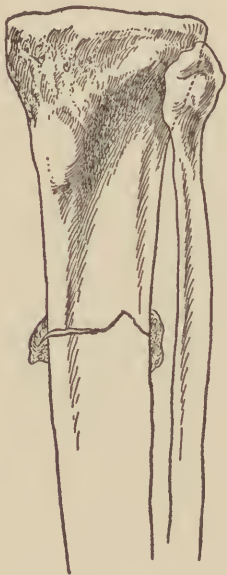
FIG. 17.—Showing transverse fracture of the tibia with "callus formation."
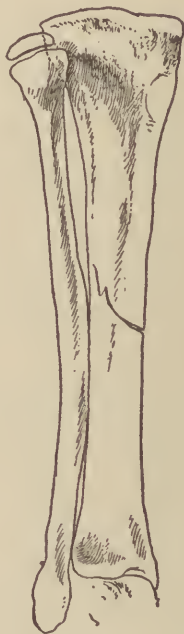
FIG. 18.—Showing an "incomplete fracture" infraction or "green-stick" fracture of the tibia.

bearing. "*Pott's fracture*" involves the lower end of the fibula and at times the internal maleolus of the tibia. It is the one most frequently seen in this region and demands accurate position and prolonged protection from weight-bearing. Fracture of the tarsals, metatarsals, and phalanges are always obscure, and are usually confirmed only by the X-ray.

ARTICULATIONS.

From a surgical standpoint, articulations are limited to the synarthroses, or movable joints (Fig. 19). (See Anatomy.) The articular surfaces of the bones involved are covered with hyaline cartilage. A CAPSULE enclosing the joint-cavity is attached about the ends of the component bones. It is composed of (a) dense fibrous tissue, reinforced by special ligaments,
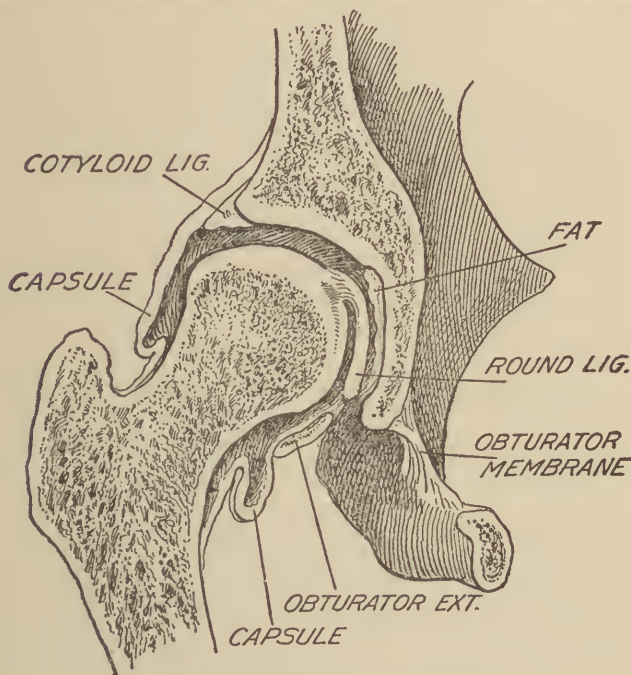
FIG. 19.—Showing structure of articulation.

and (b) SYNOVIAL lining, composed of endothelial cells, secretes the synovial fluid to lubricate the articular surfaces and prevent friction.

There are three considerations of interest, swellings, infections, and injuries.

SWELLINGS are usually due to "effusion" or increase of the synovial fluid, which may be caused by (1) injury, irritation, and (2) infection. It causes pain, limitation of motion, and

swelling which is evident on inspection or by special examination. If persistent, there follows relaxation of the supporting ligaments, and a permanently weak joint. *Treatment:* Immobilization by a suitably padded splint or bandage prevents irritation from motion and allows absorption of the fluid. Local counter-irritants and analgesics may be of value: Iodine or arnica, with hot, moist compresses. Persistence of swelling or evidence of infection may be indication for more radical measures.

"*Aspiration*" (withdrawal) of the fluid with a needle and syringe under aseptic precautions is done for one of two reasons: (1) *Diagnosis*, to determine the nature of the fluid. (a) Clear fluid is usually the result of injury or mechanical irritation, and is often absorbed with immobilization of the joint. (b) Pus or bacteria, as demonstrated by microscopical examination, indicates infection and may call for radical surgical treatment. (2) For *Treatment:* (a) Withdrawal of clear fluid to relieve pressure is usually followed by spontaneous cure. (b) To inject antiseptic solutions, iodoform oil, or formalin in glycerin, in infected cases.

INFECTIONS may occur in two forms: (1) Acute suppuration from injury or complicating infectious processes in other parts of the body. There is high fever and constitutional effects and marked local swelling, pain, and destruction of tissue. Surgical measures: Evacuation of necrotic, septic material, and the use of strong antiseptic irrigations. Drainage is rarely used. (2) Chronic, tubercular processes result as extension from component bones. Destruction of cartilage often causes ankylosis and loss of function.

INJURY AND IRRITATION.—(1) *Dislocation* involves a laceration of the fibrous capsule, through which the articular end of one of the bones protrudes and is held by muscular contraction. There is (a) pain, (b) characteristic deformity which cannot be reduced by direct pressure, and (c) limitation of motion. There is no crepitus or abnormal mobility. The condition is often confused with fracture, which may also be present. Reduction requires special manipulation to bring the dislocated bone into normal relations. Anæsthesia is usually necessary to overcome muscle contraction. Prolonged immobilization is needed to allow healing of the capsule. Recurrence is not

infrequent on account of the relaxation of the capsule. Complications include: Fracture of component bones; injury to soft parts; stiffness and limitation of motion.

(2) *Sprains* and minor injury to joints result in laceration of the capsule or tendons. There is pain and swelling, which are increased by use. Such injury requires prolonged immobilization and support by a suitable bandage or cast. There is always danger of missing a fracture, and X-ray examination is needed promptly in doubtful cases.

Loose bodies, "joint mice," result from fragments of articular cartilage or folds of synovial membrane which are separated by injury and become calcified. Such a condition is characterized by recurrent attacks of pain, swelling, and limitation of motion. The knee joint is most frequently involved. Surgical removal is necessary for cure.

The *bursæ* are sacs lined with a synovial membrane, and sometimes are continuous directly or indirectly with an adjacent joint. They are located under or between muscle tendons and prevent friction over bony prominences. Bursæ become thickened, swollen, and painful as a result of injury, persistent irritation, or infection, resulting in serious limitation of motion. Surgical treatment, excision or evacuation of contents, is indicated in certain cases. Examples: Prepatellar bursitis ("Housemaid's Knee"), the bursæ about the elbow, or shoulder joint.

DEMONSTRATIONS

1. X-ray plate showing elbow of child to show secondary centres of ossification.
2. Demonstrate or discuss in detail a specific case of osteomyelitis with sinus formation, and have one of class report on the operative findings and subsequent history.
3. Demonstration of X-ray plate taken to show regeneration of bone several months after resection.
4. X-ray plates showing localized tuberculosis of bone, tumors, and cysts.
5. X-ray plates showing various types of fracture: green-stick, complete, spiral, comminuted, and impacted.
6. X-ray plate taken after reduction, showing apposition and callus.
7. Demonstration of "pillow-splints" and various "first-aid" dressings.
8. Demonstration of special apparatus and splints for immobilization.
9. X-ray of late case showing marked deformity.
10. Instruments and apparatus for open treatment of fractures.
11. Demonstration of Thomas and modified splints, and special apparatus for overhead extension.

CHAPTER VII

VASCULAR, LYMPHATIC, AND NERVOUS SYSTEMS

The **Vascular System** includes arteries, veins, and capillaries. The student should also review the physiology of the systemic, pulmonary, and portal circulation.

Arterial System.—From a surgical standpoint, we have to consider: Collateral blood-supply, aneurism, and transfusion of
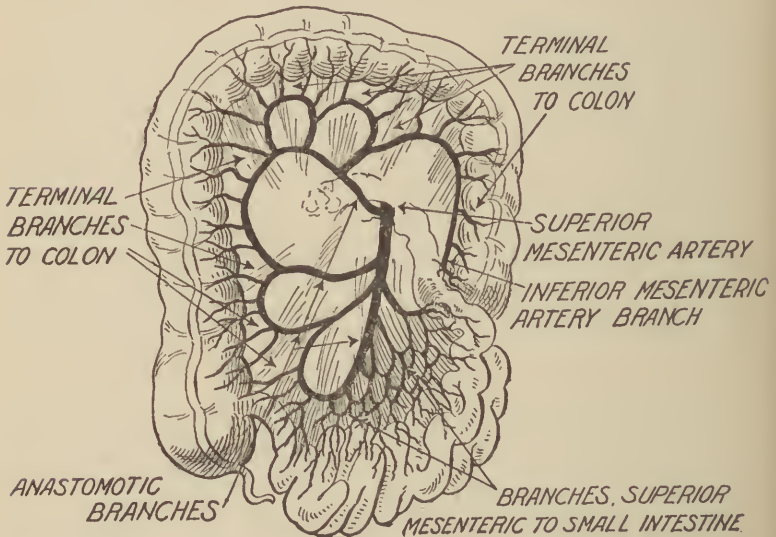
FIG. 20.—Superior mesenteric artery showing anastomoses and terminal branches.

blood. The arteries carry blood to the tissues of the body, and interference with the normal supply cuts off the oxygen and nutrition to the part involved. A "principal artery" (example, brachial to the arm) is the chief source of supply to a given region.

1. COLLATERAL CIRCULATION, composed of vessels of independent origin, and also anastomoses between branches given

off the principal artery at different levels, furnishes an auxiliary blood-supply to most regions of the body (Fig. 5, page 26, and Fig. 20). A *terminal artery* is one which constitutes practically the sole blood supply to a special region, with no collateral or auxiliary circulation.

Principles: Complete occlusion, by ligation or embolus, of a

ANEURISM
POPLITEAL ART
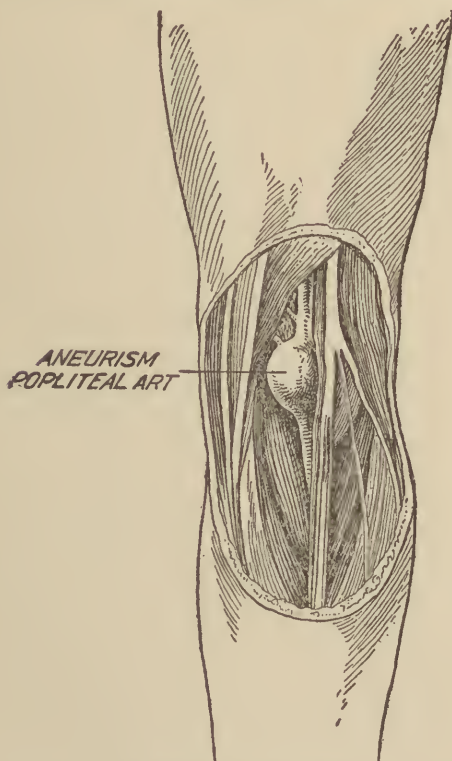
Fig. 21.—Popliteal aneurism.

terminal artery usually causes gangrene or necrosis of the dependent tissues. If the principal artery be gradually occluded from any cause, collateral branches and anastomoses compensate to a greater or less extent, the dependent tissues receive some blood, and gangrene may be avoided, or will involve only the most dependent parts. Example, toes. If the occlusion be

gradual and the collateral circulation abundant, compensation will be adequate. Sudden complete occlusion (ligation) of a principal artery, except at certain points, does not allow for compensatory development of collateral circulation, and more or less atrophy or gangrene is unavoidable.

2. ANEURISM (Fig. 21).—This is a localized dilatation of an artery due to weakening of the wall as a result of disease. The aneurism may be sharply circumscribed, "saccular," or "diffuse." The condition is of most interest in the larger vessels, aorta, axillary, or the principal branches, though it may be present in any artery. There results a thin-walled tumor which pulsates actively with each heart-beat. Pain is marked, due to the intermittent pressure. Rupture and hemorrhage are the most serious complications, and finally cause fatal loss of blood. The presence of an aneurism may interfere with adequate blood supply to dependent parts. The pulsating tumor often erodes solid structures, bone or cartilage, with which it comes in contact and causes great pain.

Treatment includes: (*a*) Palliative measures to prevent rupture, specific and constitutional treatment to reduce blood-pressure, influence local disease, or promote spontaneous coagulation of the contents and obliteration of the sac. (*b*) Curative surgical procedures: Ligation of the vessel above or below the sac, possibly also excision or reconstruction of the aneurism, introduction of silver wire into the sac, with or without electricity to promote coagulation and obliteration of the aneurism.

3. TRANSFUSION of blood refers to the transferring of whole blood from the vessels of one individual to those of another. *Indications* include: (*a*) Sudden severe hemorrhage. (i) To supply volume of blood and raise the blood-pressure, and insure adequate circulation to the brain and vital centres. The cause of death in immediately fatal cases of hemorrhage is anemia of the brain due to low general blood-pressure. (ii) To furnish blood elements which are deficient as a means to control certain types of hemorrhage. (iii) To overcome the resulting anemia. (*b*) In certain diseases (example, pernicious anemia and chronic infections), for therapeutic effect aside from the anemia.

Methods.—(*a*) DIRECT, the artery of the "donor" is brought into direct continuity with the open vein of the patient, either by means of suture of the ends or sides of the vessels to each

other or by special canulas.   The whole blood is allowed to
flow directly from one individual to the other.   (b) INDIRECT
transfusion, blood is withdrawn from the veins of the "donor"
and injected into the veins of the patient by means of syringes
of special apparatus.   The greatest difficulty is coagulation of
blood in the needles or canulas, which is sometimes overcome
by the addition of certain substances (sodium citrate to make
an 0.2% solution with the blood given.)

Veins.—Thrombosis, varicose veins, and phlebotomy.

1. THROMBOSIS refers to the coagulation of blood within
a blood-vessel, usually a vein, resulting in the occlusion of that
vessel.   *Causes:*   (a) Local infectious processes cause throm-
bosis in adjacent veins which may extend to large vessels.
Example: Middle ear or mastoid infections cause thrombosis
in the jugular or lateral sinus of the brain.   (b) Remote septic
processes or systemic infections, typhoid.   (c) Local lesions or
injuries, varicose veins, hemorrhoids, pressure of tumors.
(d) Post-operative or puerperal thrombosis occurs in remote
vessels even when there is no apparent evidence of sepsis.
(e) Constitutional changes may be an indirect causal factor.
Location: Except in cases adjacent to local infection, throm-
bosis occurs most often in the iliac or femoral vein, and because
of certain anatomical influences, is more frequent on the left
side.   It is commonly spoken of as "milk leg" or by the surgeon
as "phlegmasia alba dolens," literally, painful white swelling.

Effects and Dangers.—(a) Occlusion of the lumen of the
vein, interfering with the return of venous blood, and swelling
of the limb.   (b) Pain on account of the distention of the tissues.
(c) Danger that a portion of the clot may be dislodged and
carried as an *embolus* in the circulation, especially to the heart
or brain, with fatal results.   (d) Later there is partial re-estab-
lishment of the circulation by absorption of the clot and devel-
opment of collateral vessels.   (e) A persisting tendency to
varicose veins and swelling.   The duration is from one to two
weeks.   There is fever from 100° to 103°, with swelling of the
limb, pain, and tenderness in the thigh.

Principles of Treatment.—Absolute rest in bed and complete
immobilization of the limb is necessary to prevent separation
of fragments of the clot.   A cradle or support for the bedding
should be used to protect the limb.   Local application of sooth-

ing lotions (lead and opium) or salves (belladonna), with a
well-padded flannel bandage, are of value to relieve pain.

2. VARICOSE VEINS consist of dilated tortuous and distended
veins. The condition is found most often in special regions where
the veins are poorly supported by surrounding tissues, *i.e.*, sub-
cutaneous and submucous, and where the vessels support a long
column of blood: internal saphenous, hemorrhoidals, or sper-
matics; but the term usually refers to the condition in the limbs.

Causes.—(*a*) A partial interference with the flow of blood by
the pressure of tumors or masses, or remains of thrombi.
(*b*) Heart lesions with venous congestion. (*c*) Occupations
requiring prolonged standing, weakening of the vessel walls,
repeated distention, and loss of tone in surrounding tissues.

Course and Complications.—The condition is persistent and
tends to increase in extent. The tissues become honeycombed
with distended veins. The dependent tissues are passively
congested and have decreased resistance to injury or infection
on account of poor blood-supply, thus explaining the tendency
to varicose leg ulcers. Rupture of a distended vein to the surface
with sharp hemorrhage is not uncommon. Thrombosis of the
varicose vessels with infection occurs especially in hemorrhoids.

Treatment.—Palliative measures consist of supports to the
part by means of elastic stockings or a pressure bandage of
canton flannel. These give considerable relief and improve
the local circulation, but are in no sense curative. Surgical
measures include a variety of procedures: (*a*) Excision of the
principal veins involved. (*b*) Ligation of the larger veins. Re-
sults are usually good.

3. PHLEBOTOMY, literally opening a vein, may be done:
(*a*) By means of a sharp aspirating needle introduced through
the skin into one of the superficial veins of the forearm, made
prominent by a pressure bandage or light tourniquet above.
(*b*) The vein is exposed by dissection under local anæsthesia
and a canula introduced. Blood may be withdrawn in small
amounts for bacteriologic study or special tests, or in larger
amounts for therapeutic reasons. Substances may be intro-
duced into the veins in special treatments: blood in transfusion,
saline or similar solutions, drugs (salvarsan).

Lymphatic system, in relation to infections and malignant
disease.

1. INFECTIONS.—(a) Acute processes (see page 12). Septic material, bacteria, and toxines from local lesions are taken up, first by the lymph vessels, and reaches the neighboring lymph-nodes. Example: from the mouth to the submaxillary nodes. These structures hypertrophy and enlarge in the attempt to destroy toxines and bacteria, thus preventing further extension. There are two possible courses: (i) Favorable; spontaneous resolution. The process is overcome in the early stage through control of the primary focus by incision and adequate 'drainage, before the lymph-nodes break down and suppurate. In this event the secondary involvement of the lymph-nodes subsides, though there may remain some enlargement. (ii) Unfavorable; suppuration of the lymph glands may take place from continued absorption of septic material from the primary focus. This is evident in superficial nodes by softening and fluctuation. After this has occurred, spontaneous resolution rarely follows and this focus must be considered as an independent septic abscess. Treatment is directed to the primary focus if this be accessible, and also to the lymph-nodes themselves.

(b) Chronic infection of the lymph-nodes is usually tubercular (see page 36), and is secondary to such lesions either in the tributary tissues or adjacent nodes. It occurs most often in children or young adults and involves the cervical, retro-peritoneal, or pulmonary nodes, surgical interest being limited to the cervical or inguinal glands. Suppuration, when present, is usually due to secondary infection. Constitutional evidence of tuberculosis is generally present.

Principles of Treatment.—(a) Specific and constitutional for tuberculosis. (b) Local applications and ointments are of slight value. (c) Surgical incision and evacuation of contents in advanced stages with suppuration. (d) Excision of involved glands in selected cases.

2. In relation to MALIGNANT DISEASE (see page 43). Involvement of lymph-nodes which are palpably enlarged occurs early in malignant disease (cancer). When present, this is evidence that the process is no longer localized, but has spread. Radical operation in all cases must include extensive dissection and removal en masse of the tributary lymph-nodes, but the prognosis is not as favorable if the tributary lymph-nodes are involved.

7

THE NERVOUS SYSTEM.

This is considered under the following headings:

A. The Central Nervous System — Cerebro-spinal { Brain { Meninges and Cerebro-spinal Fluid. Cerebrum, Cerebellum, and Pons Varolii. } Spinal Cord. }

B. Peripheral Nervous System { Spinal Cord. Cranial Nerves. }

A consideration of the anatomical structure and relations requires a review of anatomy and physiology which is not pos-

AXIS CYLINDER PROCESSES —

FROM OTHER NEURONES

DENDRITES IN RELATION TO

NEURONE AND NUCLEUS

AXIS CYLINDER PROCESSES FROM OTHER NEURONES

AXIS CYLINDER PROCESS TO

VOLUNTARY MUSCLE
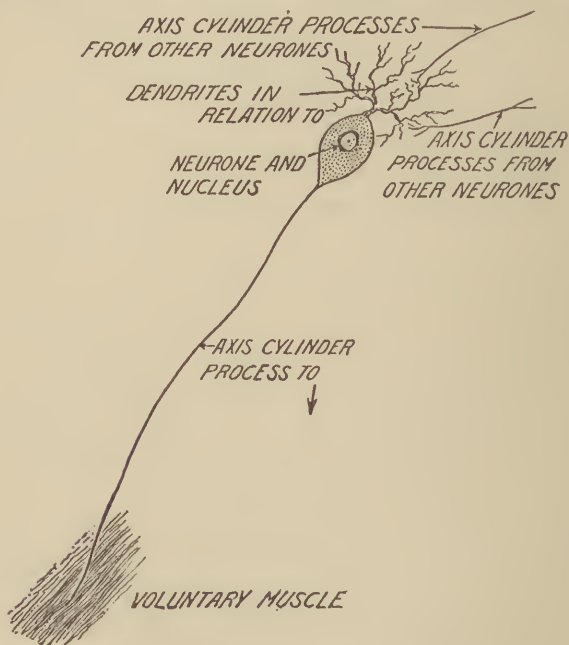
Fig. 22.—Structure of motor neurone.

sible to cover in this course. Only a few of the more important considerations will be mentioned.

The **Neurone** (Fig. 22) or nerve cell represents the essential structural and functional unit of the entire nervous system. A neurone consists of a cell body with its protoplasm and nucleus, and certain processes: the short, many-branched "dendrites" (1), and the single "axis-cylinder process" (2).

In general the dendrites receive nerve impulses from various sources and transmit them toward the cell (*afferent*), and the axis-cylinder process transmits nerve impulses away from the cell (*efferent*). The life and function of the processes depend on the neurone. Division of the fibre or destruction of the cell-body results in complete *degeneration* and loss of function of the peripheral portion of the process, including dependent structures, muscles, or sensory apparatus. If the cut ends are brought into contact there results a *regeneration* of nerve fibres and later a return of function. Such regeneration occurs also, provided
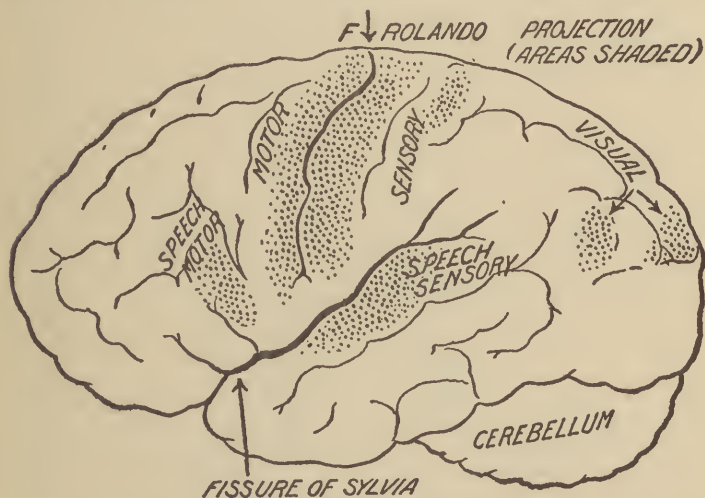
Fig. 23.—Cerebral cortex.

the cut peripheral end is brought into contact with the central ends of axis-cylinder processes of any origin.

Nerve cells are located in the "grey matter" which is found in various regions of the central nervous system. For example:

1. The CEREBRAL CORTEX (Fig. 23) contains two main groups of cells. (*a*) *Association* cells, whose axis-cylinder processes give communication between various areas of the brain. Destruction of such cells causes no well-defined motor or sensory disturbances and these regions are therefore called "silent areas." (*b*) *Projection* cells, whose axis-cylinder processes communicate with neurones at lower levels. These give

rise to motor nerves, or receive sensory stimuli from definite regions.   Destruction or lesions of such areas cause well-defined effects characteristic for the region involved.

2. The GREY MATTER of the SPINAL CORD contains a special group of *motor* neurones at various levels in the "anterior horns."
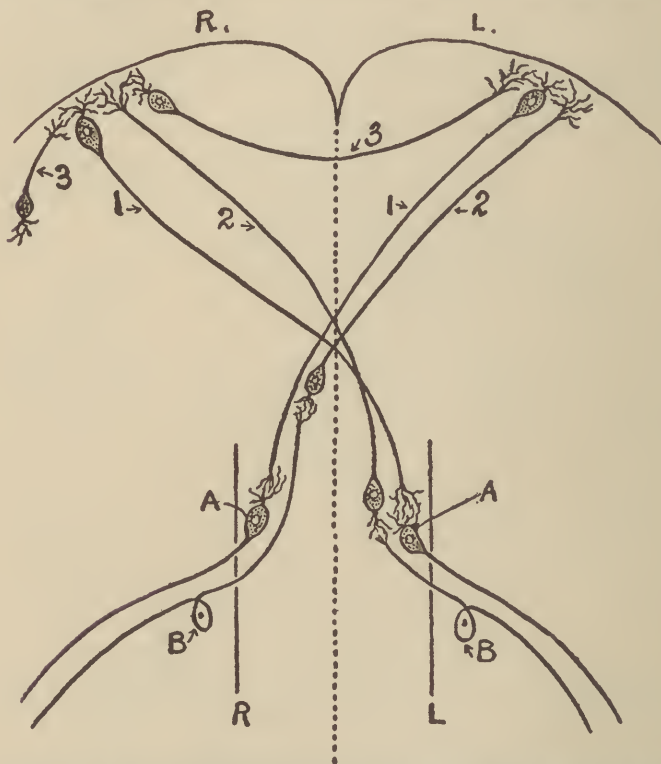
Fig. 24.—Showing relations of upper and lower segment neurones.   Upper segment: R. and L., right and left cerebral cortex; 1, projection motor neurone and fibre to anterior horn cell, A; 2, projection sensory fibre fron centre in cord; 3, association fibre.   Lower segment: R. L., right and left cord.   A, anterior horn motor cell and motor nerve fibre; B, posterior root sensory cell and sensory nerve fibre.

These cells are under the influence of the projection fibres from the "motor area" of the opposite side of the cerebral cortex, and their axis cylinders make up the motor fibres of the peripheral spinal nerves.   This represents the voluntary control of motor and other functions exercised by the brain, and is lost

through (a) destruction of the higher centres, or (b) injury or break in continuity of the "upper segment" axis-cylinder process.

3. The SENSORY fibres of the peripheral spinal nerves arise from a special group of neurones located in the "posterior root ganglions" at various levels of the cord. These neurones have a peculiar type of axis-cylinder process which divides into two branches: (a) Passes to the periphery and goes to form the sensory portion of the peripheral nerve, cranial or spinal; (b) passes to the cord and transmits sensory afferent impulses to the cord and, by means of several communicating neurones, to the cerebral cortex, where it is received as a conscious sensation. Destructive lesions may occur in either the "upper segment" or "lower segment."

(1) The *Upper Segment* (Fig. 24) includes: (a) The cerebral cortex (i) motor areas; result in a characteristic type of paralysis of certain regions on the opposite side of the body. The "reflexes" are not abolished and may be increased. (ii) Sensory areas; cause disturbance in sense perception referred to the opposite side of the body. (b) To the tracts of projection fibres lower in the brain or cord cause: (i) Paralysis at lower levels, more or less diffuse, with increased reflexes; (ii) sensory disturbances at lower levels, also diffuse.

(2) *Lower Segment* (Fig. 24), involving the motor or sensory cells in the cord or their axis-cylinder processes, cause: (a) Motor paralysis with loss of reflexes; (b) more or less localized sensory disturbances. Lesions of the peripheral nerves cause mixed motor and sensory disturbances.

Special Regions of the Central Nervous System

Central: 1. Meninges and Cerebro-spinal Cavity and Fluid. 2. Brain. 3. Spinal Cord.

Peripheral: 1. Cranial Nerves. 2. Spinal Nerves.

CENTRAL NERVOUS SYSTEM

The **Meninges** include: (a) Dura mater, (b) pia mater, (c) arachnoid, which enclose the entire central nervous system. The dura mater is a dense fibrous structure, adherent to the cranium, and carries the meningeal arteries, also the "venous sinuses" formed by folds or layers of the dura, carrying blood from the brain to the jugular veins.
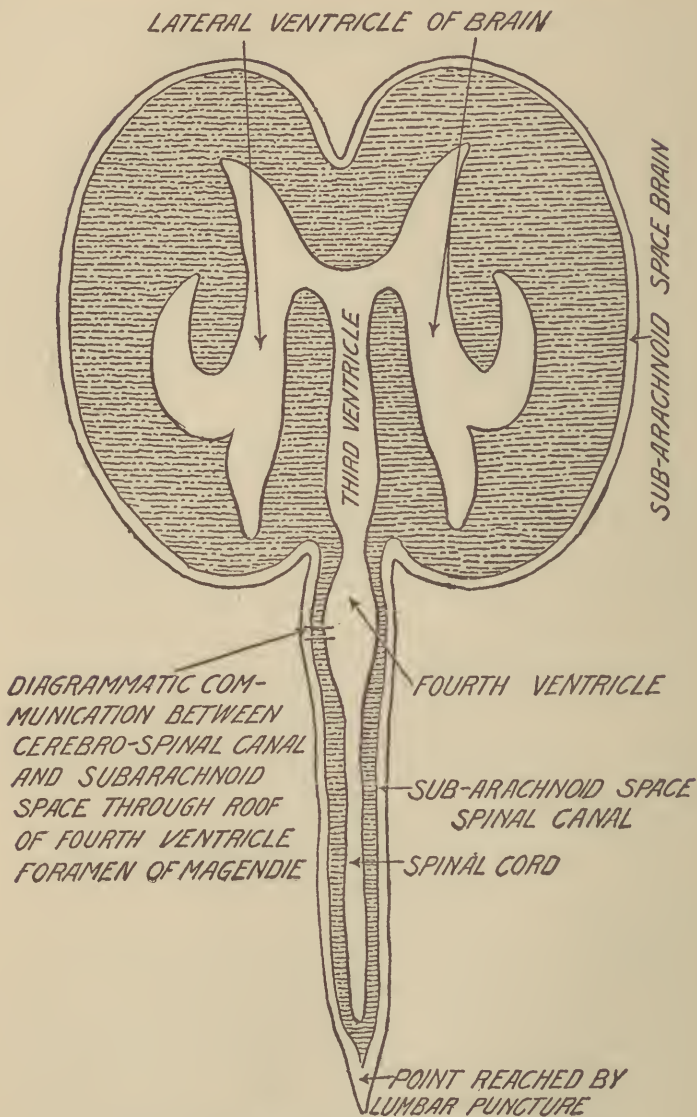
FIG. 25.—Showing relations of the cerebro-spinal spaces.

In the vertebral column the dura is attached by several ligamentous processes, but is not adherent to the bone. The *pia mater* is a delicate structure immediately adherent to the brain or cord, and carries a group of blood-vessels supplying the underlying tissue. The *arachnoid* membrane is interposed between the dura and pia enclosing the subarachnoid space and the cerebro-spinal fluid. The meninges are highly susceptible to infection, "meningitis." This may occur as a spontaneous disease due to various bacteria (example, epidemic meningitis, or tubercular), or as an acute septic meningitis complicating operative or accidental wounds, the latter form usually being a rapidly fatal process.

The CEREBRO-SPINAL FLUID is a clear substance contained within the sub-arachnoid space of the brain and spinal cord. the cerebro-spinal canal, and ventricles of the brain (Fig. 25). The cerebro-spinal space (see anatomy) includes the ventricles of the brain and the central canal of the spinal cord. It communicates with the sub-arachnoid space by means of foramina (openings) in the roof of the fourth ventricle in the region of the medulla. The cerebro-spinal fluid is derived from the blood in the venous plexuses of the ventricles of the brain, and is absorbed from the sub-arachnoid space, thus maintaining a constant equilibrium. *Functions.*—(*a*) The fluid is concerned with the distribution of nutrition, and waste-products of oxidation in the central nervous system. (*b*) Mechanically the fluid forms a water bed protecting the delicate nervous tissue from injury, and serves to equalize pressure on any part of the brain. Example: Increased pressure within the skull is compensated to some extent by an increase in pressure of the cerebro-spinal fluid in the sub-arachnoid space of the spinal cord, as may be determined by "lumbar puncture."

Lesions associated with abnormal distribution of the cerebro-spinal fluid: *Hydrocephalus* consists of a dilatation of the ventricles of the brain with cerebro-spinal fluid under increased pressure, resulting in a compression of brain substance. It usually occurs in the new-born or young children and causes enlargement of the bony cranium and separation of the individual bones, resulting in characteristic shape of the head (Fig. 26).

The causes are: (*a*) Disturbed relationship between the formation and absorption of the cerebro-spinal fluid, or (*b*)

obstruction which prevents the normal distribution of the fluid, resulting in accumulation in the ventricles. *Results:* Compression of the cerebrum, distention of the skull, protrusion of the eyes, corneal ulcer, blindness, headache, restlessness, destruction of brain substance, with idiocy or mental deficiency, and usually death. Recovery is rare, though the process may be arrested spontaneously or as result of treatment, but is likely to leave evidence of mental impairment.

Fig. 26.—Hydrocephalus.

Principles of Treatment.—Little can be done to correct the cause in most cases. Palliative measures: Withdrawal of fluid by aspiration of the ventricle relieves symptoms temporarily, or in rare instances, permanently. Various operative procedures to provide a permanent channel by which the cerebro-spinal fluid may reach other regions and be absorbed have been suggested and are occasionally successful in providing permanent relief; they nevertheless involve extensive surgical procedures carrying a high mortality, and the results are rarely satisfactory.

Lumbar Puncture.—The cerebro-spinal canal may be reached clinically by means of puncture with an aspirating needle, introduced between the lumbar vertebræ into the sub-arachnoid space of the cord.

PURPOSES.—(1) *Diagnosis.* (a) To determine the pressure of the cerebro-spinal fluid; (b) for chemical or microscopical examination of the fluid; (c) special diagnostic tests. (2) *Treatment.* (a) To withdraw fluid in case of increased intracranial pressure; (b) to introduce serum or drugs in specific diseases or meningitis; (c) for anæsthesia by the introduction of special substances in the sub-arachnoid space.

DANGERS.—(1) Infection and septic meningitis in spite of all aseptic precautions. (2) Disturbances in intracranial pressure by the withdrawal of a considerable amount of fluid, or increased pressure by injection of fluid or serum. (3) Injury to the cord is usually avoided by making the puncture between the lower lumbar vertebrae, below the level of the cord.

The Brain, including the cerebrum, cerebellum, and pons Varolii is best considered as a single structure with certain regions or centres where lesions cause definite, well-recognized effects. These special projection regions include: (1) Parts of the *cerebral cortex*, the motor and sensory areas about the fissure of rolando, and other regions concerned in the "special senses," sight, hearing, and smell (Fig. 23). (2) Lesions of the *cerebellum* cause definite effects, disturbances in equilibrium, which are fairly characteristic when carefully studied. (3) The *medulla oblongata*, which contains centres for the vital functions, cardiac, respiratory, vasomotor, and also for certain of the cranial nerves, shows characteristic and serious disturbances from lesions of any sort. For this reason injury or hemorrhage at the base of the skull causing pressure on the medulla is followed promptly by disturbances in blood-pressure, heart-beat, and respiration with early loss of consciousness or death. Furthermore, this region is not accessible to surgical approach and relief as is the region of the cortex. Other regions of the brain are regarded as "silent areas" since there are no definite characteristic effects of irritation of destructive lesions which enable the surgeon or neurologist to locate the area involved.

LESIONS of the brain from injury, infection, or new-growth cause two groups of effects:

(A) SPECIAL, depending on the irritation or injury of defi-
nite areas controlling particular muscles, functions, or regions
through projection axones. (1) *Irritation* causes convulsions
or epileptic seizures, always beginning in a definite group of
muscles, and in severe cases terminating in temporary loss of
consciousness, constituting "petit mal" or "Jacksonian epi-
lepsy." (2) *Destructive* lesions cause paralysis of definite
regions, disturbances of sensation, or loss of function. A careful
study of these effects enables the neurologist to locate the spe-
cial area of the brain involved.

(B) GENERAL effects of lesions of the brain are largely due
to increased intracranial pressure and disturbance in the cere-
bral circulation. The cranial cavity is non-expansible, and the
brain itself is not compressible, so there is no provision for
compensation of a sudden increase of the contents of the skull,
i.e., hemorrhage, depressed fracture, rapidly-growing tumor, or
abscess. The effects of increased intracranial pressure vary
somewhat according to the cause, but are fairly characteristic.
These are: (1) Faintness, stupor, or unconsciousness in marked
cases, and finally death due to disturbance in cerebral circu-
lation. (2) Severe and persistent headache, may be intermittent
in early cases. (3) Stertorous breathing associated with coma
or unconsciousness. (4) Bradycardia, abnormally slow heart-
beat, about 50 per minute. (3 and 4 are especially evident in
traumatic cases.) (5) Persistent vomiting, irrespective of tak-
ing food, may be intermittent. (6) Eye changes, especially in
gradually developing cases, degeneration of the optic nerve,
shown by ophthalmoscopic examination, and finally blindness.
(7) Increased systolic blood pressure.

Surgical Lesions of the brain include: (A) Trauma, (B)
Infections, (C) Tumor.

(A) TRAUMA.—Injury, blows to the skull, may cause dis-
turbances of the brain by (1) "*Concussion.*" There is no fract-
ure or external sign of injury, nor are there any gross lesions
of the brain itself. There is temporary disturbance of intra-
cranial pressure and the cerebral circulation, with possibly
slight hemorrhage due to rupture of small vessels. The clinical
evidences are: Temporary loss of consciousness which persists
for a few minutes or hours; gradual improvement which is
progressive and finally complete, followed by persistent head-

ache for a few days. Failure of the condition to clear, or an increase in the symptoms, is evidence of more serious injury, intracranial hemorrhage or fracture.

Treatment is essentially expectant, *i.e.*, rest in bed, possibly with restraint, ice-bag to the head, and careful observation.

(2) "*Contusion*" of the brain, with actual injury to brain substance, may be due to: 1. Laceration by depressed fragments of fractured skull. 2. Sudden pressure due to hemorrhage from meningeal vessels, or less often, from cerebral arteries.

1. *Depressed skull fractures* are usually evident on careful examination, though there may be extensive injury to the brain with few external signs. There is usually associated intracranial hemorrhage. The effects are: (*a*) Local, depending on the area of the brain involved. (i) Paralysis. (ii) Sensory disturbances. (iii) Respiratory, cardiac, or vasomotor changes from lesions of the medulla. (*b*) General effects of increased intracranial tension: Coma, unconsciousness, stertorous breathing, slow pulse, headache, vomiting, high blood-pressure.

Principles of Treatment.—Palliative measures and expectant observation in doubtful cases, or Surgical Exploration: Elevation of depressed fragments, control of hemorrhage, evacuation of clots, and relief of pressure. In properly selected cases this procedure often proves to be a life saving measure, being followed by prompt return to consciousness.

2. Sudden *intracranial hemorrhage*, due to trauma, may occur with or without fracture, and with no external evidence of severe lesion. It is usually from the middle meningeal artery and occurs outside of the dura, though rarely it occurs from other sources. There are marked local pressure effects and increase of intracranial pressure which is characteristic. The effects are local and general as in other brain lesions: (*a*) Local, depending on the special area involved, often affecting the motor region. (*b*) General: There is initial unconsciousness which is persistent in the more severe cases, but often clears within a few hours. The typical picture shows this temporary improvement and then a gradual development of signs of increasing intracranial pressure: Slow pulse, headache, vomiting, drowsiness and developing coma, with stertorous breathing. The history and course is characteristic, and all cases with head injury must be followed carefully for evidence of increasing

intracranial pressure, since early operative relief is urgently indicated in properly selected cases.

Principles of Treatment.—Evidence of traumatic hemorrhage is indication for surgical exploration over the middle meningeal artery: (*a*) To relieve intracranial pressure and remove clots; (*b*) to control bleeding. The prognosis is good in simple cases which are given prompt relief. *Apoplexy:* Spontaneous hemorrhage from cerebral vessels is less frequent except where there is preëxisting disease of the arteries. It causes destruction of brain substance, but is usually not accessible to surgical relief.

(B) Surgical Infections of the Brain:

(1) *Septic meningitis* complicating: (*a*) Surgical operations on the brain or cord; (*b*) accidental perforation of the meninges in operation on the mastoid, frontal sinus, or nose; (*c*) accidental wounds or compound fractures. The process is usually virulent and rapidly fatal, being influenced but slightly by treatment.

(2) *Brain abscess* is usually secondary to septic processes in neighboring structures, to which the body has developed some degree of immunity. Therefore a brain abscess may be chronic in its course, and cause considerable destruction of tissue with but little constitutional effects.

Causes.—(*a*) Septic wounds of the scalp, infection being carried by perforating lymphatics or veins. (*b*) Compound fractures. (*c*) Infection in the middle ear, mastoid, frontal, or nasal sinuses.

Course.—Except in the cases associated with septic meningitis, there is gradual development and slight constitutional effects. The temperature is often subnormal, and the pulse slow. Headache is marked and persistent. There is evidence of a gradually increasing intracranial tension and later signs of exhaustion. The condition may extend or rupture into the ventricles or free meningeal space, resulting in increase of sepsis and death.

Recognition of a brain abscess is often difficult except when the history is suggestive. Surgical treatment: Exposure of the cavity, evacuation of contents, and drainage are possible when the abscess can be located and is accessible, but the prognosis is never bright.

(C) TUMORS OR NEW-GROWTHS are most often primary and are derived from the supporting tissues. Some of the more common types include: (1) Osteoma, developing from the cranial bones often at the site of a fracture. (2) Glioma, from the supporting cells of the nervous tissues. (3) Fibrous growths from the meninges. (4) Angiomata of various types, from the vascular tissues of the brain. (5) Sarcoma, developing from one of the above sources. (6) Infectious masses, syphilitic or tubercular.

The *course* is slow and obscure in the early part of the process *Effects* are (1) local, and (2) general.

1. *Local effects* are evident only when special areas of the brain are involved: motor centre, sensory regions, special sense areas, the medulla, and nuclei of the cranial nerves.

2. *General symptoms* are due to a gradually increasing intracranial pressure, and may be months or even years in developing: (*a*) Headache, at first periodic and later persistent. (*b*) Eye symptoms; abnormalities in color vision, and later failure of vision and blindness. Ophthalmoscopic examination of the eye-grounds early in the process shows definite changes in the retina and degeneration of the optic nerve. (*c*) Vomiting, with no relation to eating. (*d*) Finally, periods of stupor. In this connection it should be emphasized that certain symptoms— intense periodic headache, attacks of vomiting without apparent cause, or disturbances in vision—developing over a short period of time, call for thorough examination by a competent neurologist or ophthalmologist. By following this course it will be possible in certain cases to make an early diagnosis and offer reasonable hope of relief by suitable operation.

Treatment is entirely surgical: (*a*) Craniotomy, "decompression" to relieve intracranial pressure and relieve symptoms; headache, vomiting, and failing vision. (*b*) Removal of the tumor in cases where it can be located and is accessible, or as a second stage following decompression.

The *Pituitary body* situated at the base of the brain in the "sellum turcica" is occasionally of surgical interest, and is best considered in connection with the brain. *Function:* It is a glandular structure and provides an internal secretion which is important in the early development of the body—bones, subcutaneous fat, and sexual organs—and has a marked influence

on body metabolism.   Surgical interest is confined to tumors or
enlargements associated with destruction of the gland.   Results
are: (a) Mechanical, pressure on neighboring structures; optic
nerve, disturbance of vision, venous sinuses, and increase of
intracranial pressure.   (b) Developmental disturbances, due
to abnormal secretion: Enlargement of certain bones, skull,
long bones of hands and feet, overdevelopment of fat, mental
changes, drowsiness or stupor, loss of sexual characteristics,
and disturbances of metabolism.   The development of the
clinical picture is gradual and inconstant.   Recognition of the
condition is confusing and the diagnosis can only be made by
expert observation.   Operation, removal in selected cases by a
skilled surgeon, offers a fair prospect for marked improvement.

3. **The Spinal Cord.**—This structure is composed of two
distinct portions, each having separate functions.   A. White
matter, consisting of columns of nerve fibres which communi-
cate: (1) Between various brain centres and the cells of origin
of the peripheral nerves in the cord; (2) between neurones at
various levels of the cord. B. Grey matter (Fig. 27), which
contains: (1) Motor cells whose axis-cylinder processes form
the motor fibres of the peripheral nerves; (2) intermediate
cells whose processes communicate between different levels
of the cord or carry sensory impulses to the brain.   (3) *Pos-
terior* root ganglia are not, anatomically, a part of the cord,
but are located in connection with the posterior root of the
peripheral nerves.   The axis-cylinder process is bifurcated, one
branch making up the sensory part of the peripheral nerve, the
second passing to the cord and transmitting sensory impulses
directly or indirectly to the brain.

Lesions of the cord may affect either the white matter or
the grey matter, or more often are combined. (1) Lesions of the
white matter disturb the various communicating tracts of nerve
fibres, and the effects are less definite than when the grey matter
is involved.   Extensive or complete transverse lesions cut off
communication between the brain and nerve cells or secondary
centres at lower levels in the cord.   Certain disturbances are
common: (a) Loss of "tissue tone," development of trophic
ulcers, and bed-sores.   (b) Loss of control of the bladder and
rectum, with incontinence of urine and fæces.   These effects
often cause serious complications, which fact renders the

prognosis of serious injury to the cord extremely grave unless the cause can be promptly removed. (2) Lesions of the *grey matter* cause destruction of a group of motor cells and degeneration of the corresponding motor nerve with paralysis. Injury to the posterior root ganglions cause sensory disturbance. Since the centres are arranged in a definite manner and give origin to segmental nerves with a definite distribution, it is possible to determine the location of a lesion by study of the distribution of resulting disturbances, motor or sensory. (3) Most lesions of the cord involve both white and grey matter, and the effects are therefore combined. That is, there are:
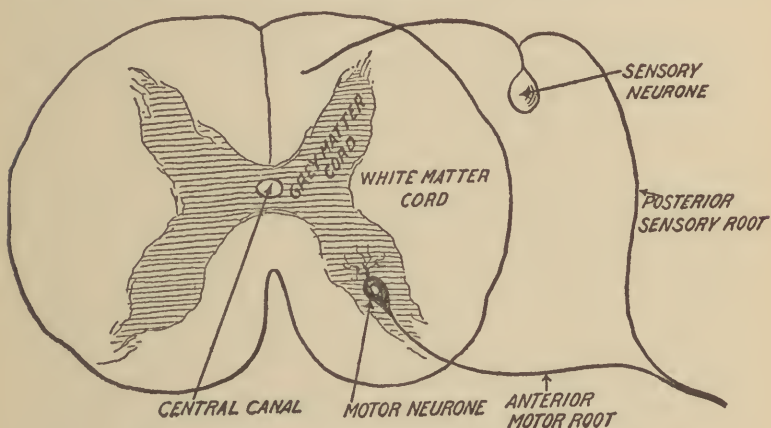
FIG. 27.—Spinal cord and origin of peripheral spinal nerve fibres.

(*a*) Motor and sensory disturbances in the area supplied by the peripheral nerves which originate at the level of the lesions. (*b*) A variety of trophic, motor, and sensory disturbances due to injury to communicating tracts.

SURGICAL LESIONS of the cord may be caused by: (1) injury, (2) disease, or (3) tumor.

1. *Injury* from depressed fracture of the vertebral column may cause lacerations of the cord or compression. When it is possible to locate the level of the lesion by the distribution of the motor and sensory abnormality, surgical measures, elevation of fragments and relief of pressure, are indicated. Prompt treatment may result in complete recovery. Hemorrhage associated

with fracture does not cause as severe effects as that within the skull.

2. *Deformity* and curvature of the spine due to disease and necrosis of the vertebræ, tuberculosis, "Pott's disease," may cause serious pressure, or this may be due to extension of the process and thickening of the meninges. Treatment of these cases can only be directed to correct the deformity and relieve the pressure on the cord. Certain infections, acute anterior poliomyelitis, cause destruction of the motor cells of the cord, with permanent paralysis of the muscles supplied by the corresponding motor nerves.

3. *Tumors* occurring in relation to the spinal cord are of the same origin as those of the brain. The effects are gradual in their development, but a careful neurological study will often locate the level of the lesion. Surgical removal and relief of pressure is possible in many cases.

PERIPHERAL NERVOUS SYSTEM

Cranial nerves include the twelve pairs of special nerves given off from nuclei in the brain:

1. OLFACTORY, nerve of smell, injured in lesions or operations on the upper nasal passage.

2. OPTIC, nerve of sight. Involved in atrophy by increased intracranial pressure, compressed by tumors of the base of the brain or the pituitary body.

3. OCULO-MOTOR, also concerned in control of the pupil. Affected by lesions about the medulla or base, causes squint, loss of reflex to light, and unequal pupils.

4. TROCHLEAR, to eye and upper lid, paralysis causes drooping of upper lid.

5. TRIFACIAL, sensory nerve to the face, nose, mouth, and throat, and motor to the muscles of mastication. It is of most interest in connection with "trifacial neuralgia," the cause of which is indefinite or unknown. The condition is persistent or recurrent and is associated with spasmodic excruciating pain in the region supplied by one or more branches of the nerve. Surgical treatment aims to destroy the branches, or, in extreme cases, to destroy or remove the ganglion of the nerve, (*a*) by injecting the nerve through one of the foramina (bony openings), where it leaves the skull, with alcohol or other agent. (*b*) Inject

the ganglion where the cells of origin are located, through the proper foramen. (c) Surgical removal of the ganglion.

6. ABDUCENS NERVE, motor to the external rectus of the eye, is involved in lesions of the base of the brain, and causes disturbances in the movements of the eyeball.

7. FACIAL, motor to the muscles of expression of the face. It is involved in lesions of the medulla, petrous part of the temporal bone, internal ear, and mastoid process, resulting in paralysis of the muscles of expression, with typical deformity.

8. AUDITORY NERVE, involved in lesions of the medulla, base of the brain, temporal bone, causes permanent deafness on that side.

9. GLOSSO-PHARYNGEAL, sensory to the tongue and pharynx.

10. VAGUS or PNEUMO-GASTRIC nerve, has an extensive motor and sensory distribution. It is involved in lesions of the base of the brain, or medulla, and causes serious or fatal disturbance in respiration or circulation. Special branches may be injured in surgical operations about the neck.

11. SPINAL ACCESSORY, motor to the trapezius and muscles of the neck, is most often injured or cut accidentally in the removal of enlarged cervical lymph-nodes, and results in inability to raise the shoulder.

12. HYPOGLOSSAL nerve, motor to the muscles of the tongue.

Peripheral *spinal nerves* are given off in pairs, and leave the vertebral canal between the bodies of the vertebræ. Each nerve is mixed, *i.e.*, contains motor and sensory fibres. In certain regions several segmental nerves form a "plexus" where the fibres are intermingled and rearranged in special nerve trunks. (See Anatomy of the Brachial Plexus, Fig. 28.)

Lesions of a nerve proximal to a plexus cause more diffuse effects than those of a special trunk, *i.e.*, there will result a "paresis" (weakening) of a group of muscles instead of paralysis of a smaller number, and the sensory disturbance will be less definite and cover a greater area. By means of special studies of the area concerned it is possible to determine the nerves which are involved, and the location of the lesion. Complete separation of a nerve fibre or destruction of its motor cells in the cord is characterized by the typical "reaction of degeneration" in the muscles concerned. In this case it is

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assumed that recovery is impossible, and the only hope of relief lies in the possibility of re-establishing the continuity of the peripheral nerve by surgical operation.

Lesser degrees of disturbance where the continuity of the nerve fibres is not broken, resulting from torsion, disease, exposure to cold, or toxæmias, offer a better prognosis, after rest, massage, and electrical stimulation.
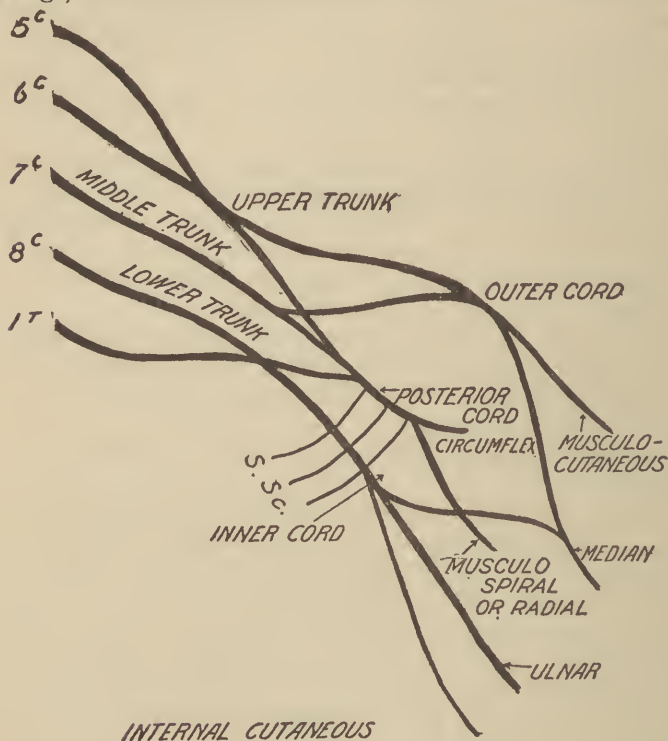
Fig. 28.—Brachial plexus. 5C, 6C, 7C, 8C, and 1T, lower cervical and upper thoracic spinal nerves.

"*Neuritis*" is a term commonly used by patients to refer to almost any localized pain which may be due to a wide variety of causes. In many such instances there are underlying constitutional diseases, in others there is general toxemia from a local focus of infection in a tooth, tonsil, sinus, gall-bladder, etc.

The condition is persistent, and variable, with frequent recurrences, locally or in other regions. Local treatment includes: liniments, light massage, heat, or hot, moist compresses and rest. Constitutional: to improve the general condition of the patient, and remove any special underlying cause. In most persistent cases, it is necessary to make a thorough diagnostic study to locate a remote focus of infection.

True *Neuritis* due to lesion of a peripheral nerve is rather rare. It is associated with severe localized pain together with tenderness along the course of the nerve involved. Swelling of the nerve can often be demonstrated. Causes include: injury, chilling, chronic constitutional intoxication or poisoning, such as lead, alcohol, and other more or less remote conditions.

Treatment involves prolonged rest, immobilization, sedatives and hypnotics together with relief from the underlying cause.

DEMONSTRATIONS

1. Case or specimen of an aneurism of peripheral artery, popliteal.
2. Apparatus and solutions for transfusion of blood.
3. Demonstration and practice in applying pressure bandage for varicose veins.
4. Demonstration of padded bandage and protection for phlebitis.
5. Demonstration of cases or histories showing involvement of lymph-nodes; (a) with resolution following incision and drainage of primary focus; (b) with suppuration of lymph-nodes.
6. Tuberculous involvement of lymph-nodes.
7. If possible, demonstration and explanation of effects of (a) "upper segment" paralysis (apoplexy), (b) "lower segment" paralysis lesion of cranial or peripheral nerve.
8. Demonstration of apparatus and method of "lumbar puncture."
9. Study of case or history of concussion of brain with recovery.
10. Case or case history of traumatic intracranial hemorrhage.
11. Same of brain abscess or septic meningitis following injury or operation.
12. Demonstration of case with complications of serious injury to the vertebral column and cord.

CHAPTER VIII

THE HEAD—CRANIUM AND FACE.

THE *Cranium* includes the portion of the skull which encloses the brain. The *vault* is composed of the squamous or flat portions of the frontal, occipital, and parietal bones. The *base* is formed by the orbital plate of the frontal, the body and wings of the sphenoid, the petrous part of the temporal, and the basilar part of the occipital bones.

The *coverings* of the cranium are: (1) The *scalp*, composed of thick skin, rich in hair follicles and sebaceous glands, with its vascular dense fatty layer. (2) A *fibrous* layer composed of the aponeurosis of the fronto-occipitalis muscle, attached in front to the supraorbital ridge, laterally to the temporal fascia, and posteriorly to the occipital bone. (3) The *periosteal* layer of the cranial bones is attached firmly along the suture lines, hence collections of blood or pus are definitely limited.

Surgical lesions of the scalp include: (A) Wounds, (B) Infections, and (C) Tumors.

A. Open wounds are usually of the "incised" type, even those resulting from blows or injury with a blunt instrument. The edges of the wound gape, especially if the aponeurotic layer is involved.

(1) Hemorrhage is always free, since the blood-supply is rich, though rarely becomes serious and is easily controlled by pressure bandage or suture of the wound. (2) Infection is common in an accidental wound of the scalp, though it seldom makes much progress if properly cared for. In some cases where the wound has been closed tightly, with inadequate provision for drainage, extensive infection and sepsis may develop. When the sub-aponeurotic layer is involved, purulent material collects under the fascia, being limited only by the attachments of the fronto-occipitalis muscle. Adequate drainage is difficult to secure, and healing is slow. Extension by means of perforating lymphatics or veins through the skull may result in periostitis, meningitis, or brain abscess.

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(3) Injury to the skull or brain may occur, complicating any scalp-wound due to violence, and must be definitely excluded before the case is dismissed from surgical care.

First Aid.—The hair surrounding the wound is shaved or clipped, the area cleansed by antiseptic irrigation or swabbing with tincture of iodine, pockets explored and foreign material removed. Interrupted sutures are commonly used to allow drainage and to prevent undue tension in case of infection. Wet antiseptic dressings may be indicated.

B. Infections of the scalp may complicate wounds, or arise spontaneously as mild abscesses or furuncles. The rich blood-supply offers strong resistance, and prompt healing is the rule if there is adequate drainage. Infections are usually well localized and extension is limited by the dense fibrous structures of the subcutaneous tissue, except where the process has extended under the aponeurosis. Infections of the bone under the periosteum are limited by the attachment of the periosteum along the sutures. The complications have already been discussed.

CARBUNCLE represents a chronic type of infection, usually located at the back of the neck near the hair line, and characterized by a progressive destruction of tissue, and sluggish but continuous extension. It is associated with and caused by constitutional disease: Diabetes, advanced nephritis, and low general resistance. The prognosis is grave, since in many cases the process seems to extend in spite of usual local treatment.

C. Tumors of the scalp include some which are congenital or present at birth. "Meningocele," a rare congenital condition due to protrusion of the meninges, dura, and arachnoid between the sutures of the cranial bones. Such a sac contains cerebrospinal fluid and communicates directly with the cerebrospinal space, and becomes tense when the child cries or strains. The tumor is characterized by the fact that compression raises the intracranial pressure and causes unconsciousness. There are often other congenital defects. Spontaneous cure is rare, and surgical measures are usually necessary, but meningitis is a frequent complication. Recurrence is not uncommon. Other tumors of the scalp are usually of slight consequence. They include sebaceous cysts, "*wens*," and are often multiple. Such tumors may reach considerable size, and recur unless all of the secreting epithelium lining of the cyst is removed. Infection

may occur from the surface, due to irritation.   Surgical removal can usually be done under local anæsthesia.

INJURIES to the scalp and skull may occur at birth from forceps delivery, or from pressure during slow, difficult delivery.   (1) Lacerations or bruises of the scalp heal kindly with compresses of boracic acid solution.   (2) Localized collection of blood or fluid under the scalp, due to pressure, is usually absorbed spontaneously and is of slight consequence.   (3) Injury to the skull with depression of the bone causes serious lesions of the underlying brain, or extensive intracranial hemorrhage. This may result in death within a few hours or days, or leave permanent defects.   In certain cases early decompression operation, elevation of the depressed bone and evacuation of clots, is indicated and gives marked results.

FRACTURE of the vault or of the base of the skull represents the chief surgical lesion of the bony cranium and results from direct violence, blows to the head, or falling and striking the head against a solid object.   Two types of fracture are described. (1) Depressed fracture, causing laceration and local pressure on the brain with marked disturbance.   (2) Linear fracture with no displacement of bone or external evidence of injury, though there may be extensive intracranial hemorrhage.

1. Fractures of the vault of the skull occur at the site of violence but have a tendency to extend, especially to the base, as linear fractures.

2. Fractures of the base occur as independent lesions from violence, or more often as an extension of a fracture of the vault. These are more serious because of the relations of the vital centres in the medulla which are directly exposed to pressure. The prognosis is exceedingly grave.   Many patients never regain consciousness.

EFFECTS OF FRACTURE are (1) local, and (2) general.

1. *Local effects* may be due to: (a) Depressed fragments of bone and laceration of brain substance.   (b) Intracranial hemorrhage due to injury to the meningeal vessels.   These effects will depend upon the area of the brain which is involved (see page 106), *i.e.*, injury or pressure affecting the motor area causes paralysis of the opposite side of the body.   Injury to the base affects the circulatory or respiratory centres in the medulla and is often fatal.   The special local effects may be ob-

scured by the general condition. Late local changes due to thickening from callus formation may cause irritation of the cortex, with spasmodic convulsive attacks or "Jacksonian" epilepsy (see page 106). New-growths have been described as developing at the site of a previous fracture of the skull, though it cannot be claimed to be a cause.

2. *General effects* are due to disturbance of intracranial tension resulting from depressed bone, or hemorrhage. There is usually unconsciousness following the injury which may persist until death ensues, especially in the more serious fractures, especially those of the base. In other instances after a variable period, minutes or hours, this clears with persisting evidence of increased pressure: stupor, headache, vomiting, slow pulse, high blood-pressure, and a characteristic mental condition of irritability, which sometimes amounts to childishness. When the disturbance is mild, these symptoms gradually clear, leaving no permanent effect. In case of serious hemorrhage, there is likely to be a clear period of consciousness following the initial unconsciousness which was due to concussion, after which there is a gradual development of evidence of increasing intracranial pressure, which may be progressively fatal.

INDICATIONS FOR TREATMENT.—Careful observation of all head injuries to avoid overlooking fracture or intracranial hemorrhage. Evidence of a depressed fracture is indication for surgical treatment: elevation of the fragment, and relief of pressure. The operation requires the most rigid aseptic technique and should be followed by marked improvement. Linear fracture and intracranial hemorrhage is recognized by evidence of local lesion of the cerebral cortex, or increased intracranial pressure, and calls for prompt surgical treatment, craniotomy and control of hemorrhage.

INFECTIONS of the skull, aside from those associated with injury, involve the same local changes and principles of treatment as periostitis. The most serious special consideration is the danger of extension by means of communicating lymph or blood-vessels, resulting in meningitis or brain abscess.

TUMORS.—Exostoses protruding from the surface of the skull are hard, non-malignant growths and are easily removed, without recurrence. New-growths involving the interior of

the skull have already been considered in connection with the brain and meninges.   (See page 112.)

THE EAR AND MASTOID PROCESS OF THE TEMPORAL BONE

A. The external ear (Fig. 29) is composed of cartilage covered with a small amount of areolar tissue and skin.   *Wounds* involving the cartilage heal slowly since there is poor blood supply.   *Frost-bites* are common but usually involve only the skin.   The subsequent swelling and congestion is extremely painful.   In case the cartilaginous portion is frozen, there may
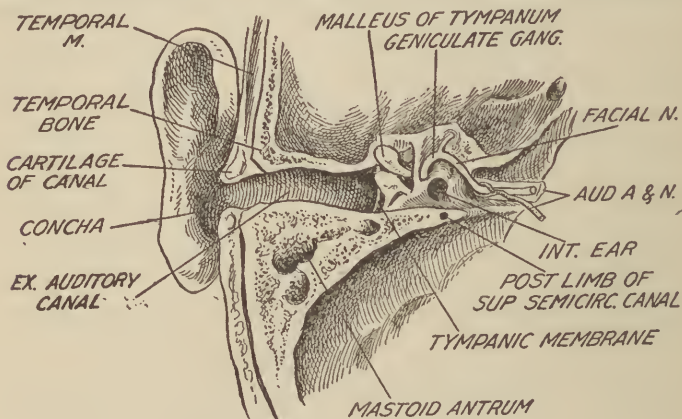
FIG. 29.—External ear and canal.

be a loss of tissue.   *Injury* from blows often results in the accumulation of a considerable hæmatoma under the perichondrium with permanent deformity.

The *external auditory canal* extends from the surface to the "tympanum" or "drum membrane" of the middle ear.   The canal is lined with cutaneous epithelium and has a peculiar secretion, "wax" or cerumen.

Lesions include: (1) infection; (2) foreign bodies; (3) collections of wax.

1. INFECTION is usually a "furuncle" or skin abscess, and is very painful.   It presents the same symptoms and indication for treatment as does an abscess elsewhere.

2. FOREIGN BODIES lodged in the canal cause pain, swelling, and interfere with hearing.   Removal is often difficult.   The

use of probes or forceps is not permissible except in the hands of experts, on account of the danger of injury to the canal or drum membrane.   The use of a syringe and water is successful in removing foreign matter, except seeds or vegetable materials which swell, in which case oil may be used.

3. Collections of CERUMEN may accumulate in the canal, forming hard masses, causing ringing in the ears, or deafness. Removal is usually accomplished by syringing the ear with a strong piston syringe.
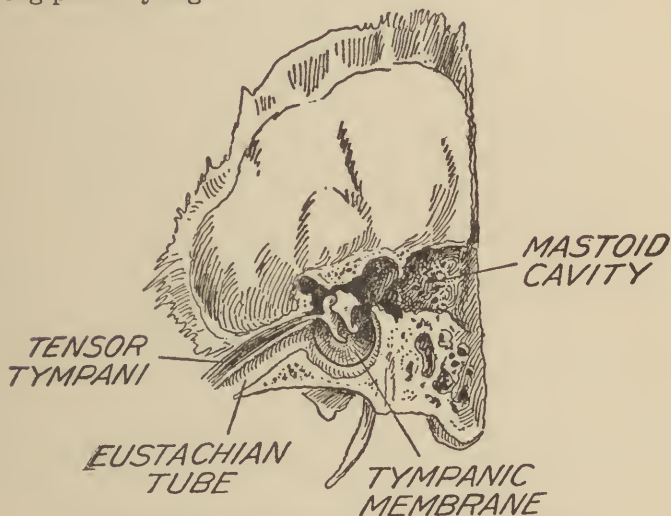
FIG. 30.—Middle ear, Eustachian tube, and mastoid cells.

B. The middle ear (Fig. 30) is separated from the external canal by the tympanum, and contains the "ossicles," malleus, stapes and incus, which transmit the sound-waves from the drum membrane to the inner ear, and special endings of the auditory nerve.   It is adjacent to the air cells of the mastoid process of the temporal bone.   It communicates with the pharynx through the Eustachian canal, by means of which infection may reach the middle ear. This communication explains the frequent sequence of acute middle-ear disease following infectious processes in the throat and tonsils.

SURGICAL LESIONS include various forms of infectious processes with their extensions to the mastoid cells.   These are

secondary to inflammation of the naso-pharynx and adenoids from tonsillitis, measles, scarlet fever, and milder or more obscure conditions, usually extending along the Eustachian tube.

Two types of INFLAMMATION of the middle ear are described:

1. *Catarrhal*, associated with mild inflammation and accumulation of serous exudate, but no suppuration. There is severe pain, "earache," usually fever, and constitutional reaction. Examination of the tympanum with a speculum shows: Injection, bulging, and evidence of fluid in the tympanic cavity. *Outcome:* (a) Favorable, spontaneous recovery with absorption of fluid and restoration of normal drainage through the Eustachian canal, with no after-effects. Indications for treatment: Heat locally, irrigations of hot boric acid or normal salt solution, or injection of 2% phenol in glycerin into the external auditory canal. (b) Progressive inflammation with suppuration.

2. *Suppurative Form.*—This represents an advanced stage of the catarrhal type which may have been of short duration and entirely overlooked. There is: Destruction of tissue, increased tension in the middle ear, more pain, fever, and constitutional reaction. Examination of the tympanum demonstrates: Bulging of the drum, presence of fluid in the middle ear, and often necrosis or rupture of the tympanum. *Rupture* of the drum membrane may occur at any stage of the disease, being followed by relief of symptoms, and a purulent discharge from the ear. It is often the first evidence of the location of obscure sepsis. Surgical incision of the tympanum is preferable to spontaneous rupture because: (a) It prevents unnecessary destruction of tissue, relieves pain and toxæmia. (b) It allows better drainage, since it can be made in the most advantageous position. (c) There is less danger of premature closure and recurrence.

The *Outcome* of the middle-ear suppuration may be: (a) Favorable. Drainage persists for some weeks till the cavity is clear, in which case recovery is complete and permanent with but little impairment of hearing. (b) Unfavorable. (i) Extensive destruction of tissues in the middle ear, with permanent impairment of hearing. (ii) Premature closure of the opening in the drum membrane, leaving septic and necrotic material in the cavity, in which case recurrence is not uncommon months or years later, resulting in a chronic discharging ear. (iii) Extension of the infection to the cancellous portion of the temporal

bone, particularly the mastoid process. This is a frequent sequel and is evident by persistence or recurrence of constitutional symptoms: Fever, toxæmia, local pain, and tenderness over the mastoid. In young children suppuration may extend to the subcutaneous tissue, and there will then be superficial signs of suppuration.

Complications in neglected cases: (1) Extension to the venous sinuses of the brain with septic thrombi which may also involve the jugular vein in the neck. (2) Brain abscess which involves the portion adjacent to the petrous part of the temporal bone. (3) Chronic suppuration, and persistent discharge, with deafness.

Principle of Treatment.—Definite evidence of involvement of the mastoid cells is indication for the "radical mastoid operation," exposure of the suppurating area, excision of necrotic tissue, and drainage to allow complete healing,

DEMONSTRATIONS

1. Case histories showing complications of scalp wounds; fracture of skull, sepsis, or brain abscess.
2. Case history of carbuncle or exhibition of suitable case.
3. Injuries to scalp and skull from difficult labor.
4. Case history of fracture of skull or exhibition of museum specimen.
5. Demonstration of external auditory canal and tympanic membrane.
6. Method of syringing the external ear for foreign body, or discharging ear.
7. History of typical case of middle-ear suppuration with extension to mastoid, showing result of perforation of drum, and radical operation.

THE FACE

This region includes the lower part of the head and skull: Forehead, eye and orbit, cheek, nose and sinuses, mouth, lips, and throat (pharynx.)

The Forehead represents the region of the frontal bone. The skin and subcutaneous tissues are highly vascular. Wounds bleed freely, but ligation of vessels is rarely required, careful suture usually being sufficient to control hemorrhage, and is necessary to prevent unsightly scar. Infections are usually local and have no peculiar significance.

Eyes.—It is possible only to mention some of the more important surgical lesions, including: (A) Injury; (B) Infections; (C) Tumors.

A. INJURY: (1) Small foreign bodies, cinders or dust, cause pain from irritation of the conjunctiva, and if neglected result in infection, conjunctivitis, or ulcers of the cornea.

Principles of treatment: (a) Removal of the foreign body by reflection of the lids requires skilful and gentle manipulation. (b) Irrigation with bland antiseptic lotion, saturated boracic acid solution. (c) Temporary compress and tight bandaging when removal is impossible.

2. Penetrating wounds of the eyeball usually cause destruction of tissue and loss of function from ulceration of the cornea, leaving opaque areas which shut out the light rays.   There may also be (a) injury to the lens and development of cataract, (b) injury to the retina or optic nerve.   Infection of the damaged eye is common and there is serious danger of extension to the uninjured eye, or "sympathetic ophthalmia."   This possibility is usually sufficient indication for the surgical removal of an eyeball which is damaged to a degree resulting in total loss of function.

Blindness may be caused by: (a) Injury from foreign body, or infection, conjunctivitis (gonorrheal) involving the cornea, resulting in opaque scar tissue which prevents the passage of light rays.   (b) "Cataract," degeneration and opacity of the lens from any cause.   The lens, however, may be removed surgically, leaving no obstruction to the light rays, but the power of accommodation is lost and must be compensated for by special glasses.   (c) Destruction of the eyeball.   (d) Lesions of he retina, optic nerve, or brain centre.

B. Surgical INFECTIONS are practically limited to those associated with injury, or due to suppurating (gonorrheal) conjunctivitis.   (See page 33.)

C. TUMORS.—The most important is a type of the melanosarcoma which develops in the pigment layer of the choroid. There are few early symptoms aside from progressive impairment of vision, and the diagnosis is made by an ophthalmoscopic examination of the retina.   The tumor is rapidly·malignant and metastases develop early in remote parts of the body.   Prompt enucleation of the eyeball is indicated, but the prognosis is always unfavorable.

It should be emphasized that disturbances in vision call for examination by a competent ophthalmologist, since the trouble

may be evidence of serious local or constitutional disease: Cataract, tumor, increased intracranial tension (brain tumor), nephritis, and certain toxæmias, for instance, wood alcohol, tobacco, etc. While the commercial optician may correct a simple error of refraction with suitable glasses, he is not prepared to exclude other causes. This distinction must be carefully explained to patients in order that they may seek and obtain competent advice.
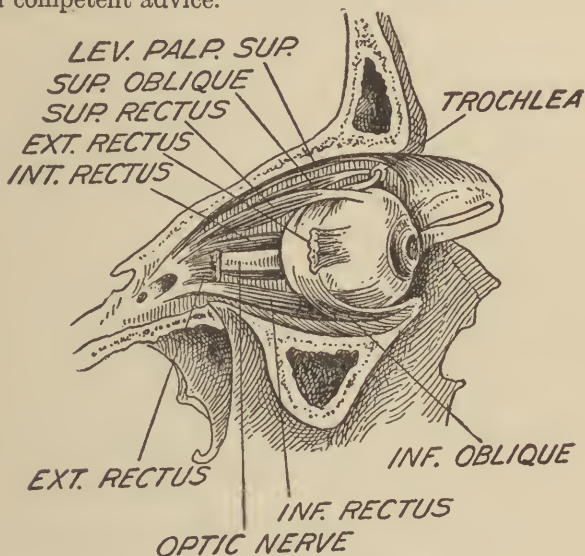
FIG. 31.—The orbit and contents.

The Orbit (Fig. 31) is the bony wall which surrounds the eyeball, composed of: The orbital plate of the frontal bone, parts of the ethmoid, sphenoid, superior maxillary, and malar bones. It contains the eyeball with its extrinsic muscles, nerves, and blood-vessels, together with a large amount of fat.

A. *Injuries* are caused by penetrating wounds which may or may not involve the eyeball. Foreign bodies of considerable size can enter the orbit without injury to the eyeball and leave no external evidence.

Dangers: (a) Injury to the eyeball.   (b) Conjunctivitis. (c) Penetration of the orbital plate and injury to the brain,

or septic meningitis. (*d*) Laceration of vessels and development of a hæmatoma or aneurism. (*e*) Extensive suppuration in the loose fat of the orbit, which is common and serious since it may be followed by meningitis or brain abscess, either through direct extension or communicating vessels, and lymphatics.

B. *Tumors* of the orbit include: (*a*) Vascular aneurisms. (*b*) Connective tissue tumors or extensions from growths in the maxillary antrum. Evidence of tumor or collection in the orbit is a unilateral "exophthalmos," *i.e.*, prominent bulging of the eyeball. Surgical removal of such tumors is difficult and recurrence is not infrequent

The CHEEK is limited above by the malar bone and zygomatic arch, and below, by the angle of the lower jaw. There are for consideration: The skin and subcutaneous fat, the muscles of expression, the facial nerve and vessels, the trifacial nerve, the parotid gland and duct (Stenson's).

The SKIN AND SUBCUTANEOUS FAT are soft and vascular.

1. *Wounds* bleed profusely and branches of the facial artery may require ligation. Injury to the parotid (Stenson's) duct may be followed by a persistent salivary fistula, and demand a special plastic operation to secure closure. Penetrating wounds to the mouth are rare. Injury to branches of the facial nerve or muscles of expression is followed by permanent paralysis. Careful suture, accurate apposition with asepsis are necessary to avoid scars.

2. *Infections*. (*a*) Erysipelas, already considered under streptococcus infections (see page 32), often occurs, apparently spontaneously, in the skin over the bridge of the nose and extends to one or both cheeks. There is local pain, swelling, and redness, with constitutional evidence of severe infection. (*b*) Superficial abscesses occur as in other regions, there being little of particular significance. Prompt incision is indicated as soon as there is evidence of suppuration, to avoid tissue destruction and unsightly scar. (*c*) Deep abscesses may reach considerable extent in the abundant subcutaneous fat. They may originate from: the parotid gland, lymph-nodes, root abscesses from carious teeth, and less often from osteomyelitis of the upper or lower jaw. There is marked pain, swelling, and constitutional effect. Surgical incision is indicated as soon as suppuration can be demonstrated. Care is necessary to avoid

injury to the facial vessels or nerves, to the parotid duct, penetration to the mouth, or excessive scar. Healing is usually rapid and complete.

The MUSCLES OF EXPRESSION include the voluntary muscles attached to the skin and subcutaneous fat and controlling the movements of facial expression. They are supplied by the VII cranial or facial nerve. Paralysis of these muscles is caused by: Disturbance of the cerebral centre or central tracts between this and the nuclei of origin of the nerve in the medulla, injury or lesion of the nerve in the middle ear, or of the nerve after leaving the skull. The paralysis involves the facial muscles, resulting in a peculiar wooden expression and lack of mobility of the features. *Outcome:* Unless the centre is destroyed or the nerve severed, which is rare except following operations on the middle ear and mastoid, there is more or less complete recovery; otherwise the condition is permanent.

In some instances where the peripheral nerve is severed, resulting in complete and permanent paralysis, it has been possible, by surgical measures, to make an anastomosis between the peripheral end of the facial and the central end of that nerve, or of another motor nerve, giving complete regeneration. Injury to branches of the nerve in wounds of the face cause paralysis of the dependent muscles.

THE TRIFACIAL NERVE (see page 112).—The most important lesion is trifacial neuralgia, characterized by severe paroxysmal pain, associated with muscular twitching and points of extreme tenderness where the three principal branches of the nerve leave the skull: (1) Supraorbital foramen, through which the terminal branch of the first division of the nerves passes. (2) The infraorbital foramen and the terminal branch of the second division. (3) The mental foramen in the lower jaw, through which the terminal branch of the inferior maxillary, third division of the nerve, passes. The *cause* are not known, but include: irritations of nerve endings by root-abscesses or remote lesions, and constitutional conditions not explained. The *course* is variable, the attacks being influenced but little by local or constitutional treatment, except measures which destroy the nerve.

Principles of Treatment.—Relief of pain is the most urgent indication. For mild attacks, heat locally or lotions and appli-

cations of counter-irritants, such as chloroform liniment or menthol, may be of value.   Hypnotic drugs must be used with care since they soon lose their efficiency and large doses may be taken.   For severe paroxysms nothing avails short of morphine in considerable dosage.   There is great *danger* of developing the habit and the drug is to be used only on the direct order of the physician for each dose.   In cases where the attacks persist or recur, more radical measures are indicated.   Unless relief is given the persistent pain and loss of sleep may give rise to the morphine habit, or even drive the patient to suicide.

Curative measures include:

(1) Injection of the peripheral branches through the corresponding foramen with a destructive agent (osmic acid) to destroy the branch.   The results are uncertain and only temporary.

(2) Injection of alcohol into the principal roots or into the Gasserian ganglion through the "foramen ovale" at the base of the skull.   In the hands of experts this foramen can be reached, by means of a suitable needle, from the surface of the face. While the technique of the procedure is difficult and there is some danger of serious complications, the results are often remarkable and permanent.

(3) Exposure of the Gasserian ganglion by surgical craniotomy followed by division of the sensory branches or total excision of the ganglion of origin of the sensory fibres.   This procedure is reserved for the most severe and persistent cases, and is an extremely serious operation, but the results are usually absolute and permanent.

THE BLOOD-VESSELS.—The temporal artery, a terminal branch of the external carotid, with the temporal veins, passes just in front of the external ear behind the angle of the jaw, where it is protected from accident.   The facial artery, also a branch of the external carotid, reaches the face over the middle of the lower jaw, where it can be palpated.   Both vessels give off branches of considerable size to the face, mouth, throat, and nose, and require ligation when concerned in hemorrhage.

The PAROTID GLAND, one of the principal salivary glands, is located in the cheek above the angle of the jaw, in front of the ear.   Passing through the gland are found branches of the facial nerve and of the external carotid artery.

Lesions: (1) Acute parotitis, "mumps," is an epidemic infection which involves this gland primarily, the causal organism of which is not known. There is marked local pain and swelling, but suppuration is rare. Complications may be serious, but the condition is not surgical. (2) Suppuration of the parotid gland is an occasional complication of (a) severe constitutional infections associated with low resistance, and (b) post-operative convalescence, probably from sepsis about the mouth, and low resistance. The complication is evidence of extremely poor resistance and gives a grave prognosis. Early incision is indicated.

(3) *Tumors* of the parotid are not common. Fibromas and mixed benign growths and various types of sarcoma are the chief tumors of this region. Localized benign growths can be enucleated, but malignant tumors are often inoperable. The parotid "Stenson's duct" extends across the cheek parallel to and below the zygomatic arch and enters the mouth opposite the second molar tooth. Infection from the mouth occasionally extends along the duct and causes suppuration in the gland. Obstruction of the duct from calculus or stricture may result in distention, suppuration or degeneration of the parotid. Injury to the duct may complicate accidental or operative wounds of the cheek, resulting in salivary fistula. Spontaneous closure occurs in simple wounds, but plastic operative measures are often required.

The Nose (Fig. 32) includes: (1) The prominent external structures, skin, and cartilage. (2) The nasal passages, septum, and communicating sinuses.

(1) EXTERNAL STRUCTURES.—The skin covering the nose is delicate, with a slight amount of subcutaneous tissue. The skin contains numerous sweat and sebaceous glands, and is a frequent site of persistent "acne." Erysipelas frequently originates in this area. Other special lesions are lupus, tuberculosis, and epithelioma. Injuries usually result in dislocation of the cartilages, or fracture at the base or "bridge" of the nose, which is often compound, most often to the mucous surface. Such injuries require careful reduction, and the use of special intranasal splints, together with sprays of mild alkaline antiseptics. Penetrating wounds of the nose which involve the non-vascular cartilage heal slowly. Syphilitic lesions are likely

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to be associated with destruction of the base or bridge, with marked deformity.

(2) The INTERNAL STRUCTURES of the nose include the two nasal passages separated by the cartilaginous septum, and limited by the lateral walls and the turbinate bones on each side, together with the communicating mucous lined "sinuses."
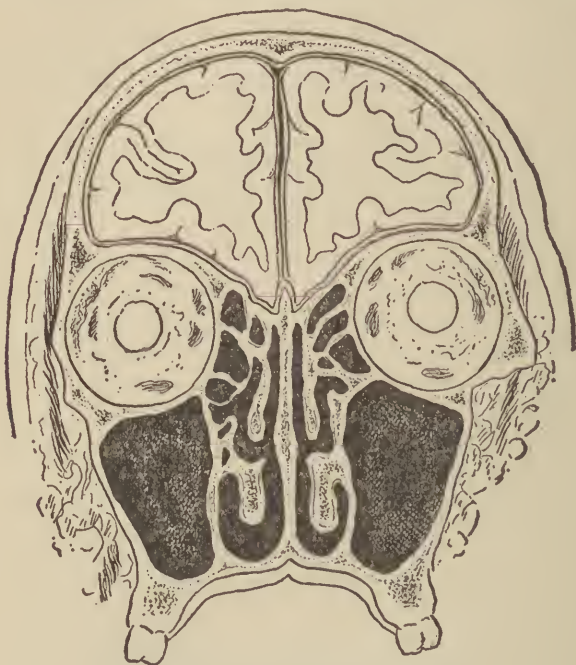
FIG. 32.—The nose and accessory sinuses.

The highly vascular mucous membrane lining the nasal passages, the septum, lateral walls, turbinates, and communicating sinuses is attached to the cartilage and bone, and is subject to various types of inflammatory lesions.

Acute catarrhal inflammation, "coryza," or common cold, is extremely frequent and is likely to involve the entire mucous membrane. Complications are: (1) Changes causing hypertrophy of the mucous membrane and submucous tissues, especially that covering the turbinate bones. This results in a recurrent and

persistent catarrh, or obstruction of the nasal passages, occasionally necessitating removal of the hypertrophied turbinates. (2) Pharyngitis, and development of hypertrophied "adenoids" or tonsils, with their resulting complications. (3) Obstruction to adequate drainage of one or more of the communicating sinuses and suppuration in that cavity.

The SINUSES thus involved are: (a) The maxillary sinus, or antrum of "Highmore," (b) the frontal sinus, and (c) the ethmoid and sphenoid sinuses.

(a) The MAXILLARY SINUS or ANTRUM OF HIGHMORE communicates with the nostril by means of an opening under the middle turbinate. It is located in the body of the superior maxillary bone, being separated from the orbit above, the cheek externally, the nostril internally, and the roots of the upper molar teeth by a thin plate of bone. Suppuration in the antrum may be secondary to: (i) Catarrh extending from the nose with inadequate drainage through the opening. (ii) Extension of a root abscess from the upper teeth. (iii) Frontal sinus infection. Acute suppuration causes marked local pain and tenderness, and general reaction of sepsis. Chronic infection may lead to recurrent attacks and remote constitutional effects. The process is often obscure and is discovered only by special examination. *Principle of treatment:* Adequate drainage must be obtained and maintained, often by repeated irrigation. Drainage may be secured: (i) By enlarging the normal opening. (ii) By puncture through the inferior nasal meatus. (iii) By puncture through the root canal of the first or second molar teeth. (iv) By incision and opening through the alveolar process of the superior maxillary bone. The results are often striking, but recurrence is not infrequent.

(b) The FRONTAL SINUS communicates with the nostrils through a canal which opens in common with that from the maxillary sinus. Suppuration in the frontal sinus is associated with acute catarrh of the nasal epithelium and obstruction to free drainage through the canal. There is: constitutional evidence of sepsis, persistent headache, local pain and tenderness. *Dangers:* (i) Sepsis; (ii) recurrent attacks; (iii) extension through the thin plate of the frontal bone, and brain abscess or meningitis; (iv) extension to the maxillary sinus.

Principles of Treatment.—Adequate drainage may be obtained through the normal canal by surgical measures, or by external exposure through the forehead.

(c) The ETHMOID AND SPHENOID bones contain air-spaces which may be infected from the frontal sinus or from the nose, resulting in suppuration. The condition is more obscure and localization of the septic focus is difficult. There is serious danger of extension, resulting in meningitis or brain abscess. The cells can be reached surgically through the frontal sinus, but there is grave danger of penetrating to the meninges, causing fatal septic meningitis.

The NASAL SEPTUM is composed of the *vomer*, the bony posterior part, and the anterior cartilaginous portion. Surgical lesions include: (1) Deflections or *spurs* which may represent congenital defects or be caused by injury or disease. They are significant when causing partial or complete obstruction of the nasal passage associated with recurrent nasal catarrh or obstruction to breathing. In such cases suitable operative procedures may be indicated. (2) *Perforation* of the septum may result from: (a) Imperfect healing of an operative or accidental wound. (b) Syphilitic ulceration. Surgical repair is difficult and often unsatisfactory. Specific treatment is indicated for syphilitic cases.

Epistaxis, nose-bleed, may be caused by: (1) Injury and rupture of submucous veins, in which case it is usually not serious and is self-limited. (2) Nasal catarrh associated with local hyperæmia and ulceration. This is often persistent but is rarely of serious consequence. (3) By high general arterial pressure often being compensatory, possibly occurring instead of serious hemorrhage in other regions, cerebral apoplexy. Recurrence is not uncommon. (4) Persistent epistaxis may be due to abnormal composition of the blood, retarding the normal coagulation and spontaneous control of bleeding. This type may reach serious proportions being uncontrolled by local measures. *Indications for treatment:* Rest in bed, freedom from excitement or exertion, cold compresses, and measures to reduce general blood pressure. Also special therapy to influence the composition of the blood. (See page 56.) *Local treatment:* Careful packing of the anterior nares, cauterization of the bleeding point where such can be found, packing of the posterior

nares, and ligation of the external carotid in persistent cases which are not otherwise controlled.

The *Mouth* includes: The lips, gums, alveolar processes, teeth, palate, tonsils, pharynx, and tongue.

The LIPS, forming the orifice of the mouth, are covered externally by a layer of skin, and are lined with mucous membrane continuous with that of the mouth. The circular "orbicularis oris" muscle, together with blood-vessels and mucous glands, is found between the two layers.

(1) *Lesions.*—Congenital deformity, HARE-LIP (see "cleft palate," page 135), may occur independently, extending from the margin of the lip towards or into the nostril, causing marked disfigurement. Repair by plastic operation is indicated.

(2) *Wounds* which involve the circular branch of the facial artery may require ligation of that vessel. Hemorrhage is always profuse, but is controlled by suture, which must secure accurate apposition to avoid scar. Asepsis in the after-care is difficult to secure, but serious wound infection is rare on account of the rich blood-supply. Adhesive strips are often applied across the wound to relieve tension on the sutures.

(3) *Infection*, cellulitis, is rarely important but is associated with marked painful swelling in the subcutaneous tissues. (*a*) Ulcers, "herpes," cold-sores, accompany certain acute infections: pneumonia, grippe, and colds; consist of blebs or water blisters. The condition is usually self-limited and of slight importance, healing promptly with some unirritating lotion or ointment. (*b*) *Fissures* or small ulcerations occur as a result of irritation. The base or crack becomes lined with tender infected granulations which may require cauterization. Further irritation must be avoided, after which prompt healing should follow. Persistent ulcers suggest malignant epithelioma. (*c*) *Chancre* of the lip occurs in accidental syphilitic infection and has a characteristic appearance with marked swelling in the surrounding tissues. The causal "spirochæta pallida" can usually be demonstrated, and specific treatment is indicated.

(4) *New-growths.*—Malignant epithelioma, originating in the mucous epithelium or that of the submucous glands, is seen most often in individuals of middle or advanced age. There is usually a history of an ulceration which persists in spite of

ordinary treatment. Therefore, one must suspect any such ulceration, especially those showing infiltration about the base. Enlargement of the submaxillary lymph-nodes is evidence of advanced malignancy.

Principles of Treatment.—Free excision of the ulcerating area with a wide margin of healthy tissue, and suitable plastic operation, represent the simplest procedure, justifiable only in early or doubtful cases. Otherwise, radical removal with dissection of the lymph-nodes in the upper anterior triangles of the neck is indicated.

The GUMS include the mucous membrane, and submucous tissue covering the alveolar processes of the upper and lower jaw, surrounding the teeth. (1) *Infections or abscesses* are usually secondary to carious teeth, extending along the root canal to the alveolar bone, and may be covered by fillings or crowns, or remain quiescent for long periods. Acute suppuration causes constitutional reaction and, locally, pain, swelling, and enlargement of the submaxillary lymph-nodes. It is often difficult to demonstrate the particular tooth which is causing the disturbance. Prompt and adequate drainage is indicated and may be obtained: (*a*) Through the root canal by suitable dental work, possible only in some cases. (*b*) Extraction of the tooth involved usually gives direct drainage. (*c*) Directly through the gum and alveolar process. (*d*) Rarely by incision through the cheek.

(2) *Chronic root abscess* may occur in the absence of previous acute suppuration about devitalized teeth, as a slow process causing constant absorption of small amounts of toxic material and remote constitutional effects: Rheumatism or neuralgia. The condition is recognized by X-ray plates, and extraction of the involved teeth is often followed by remarkable results.

(3) *Pyorrhea alveolaris* is an infection of the gums about the roots of the teeth, caused by a variety of micro-organisms. The gums become soft, bleed easily, the teeth loosen, pus can be demonstrated, and there may be necrosis of the alveolar process. The condition is often associated with constitutional disturbance, either as a cause or effect: malnutrition, anemia, indigestion, and loss of weight. *Treatment* includes dental procedures, constitutional measures, and in some cases specific vaccines.

(4) *Tumors*, other than those common to mucous epithelium, are rare. Certain benign cysts associated with abnormal tooth development are occasionally found. "Epulis," a benign fibrous growth, is not infrequent in the gums, and is removed by local excision. Recurrence is rare provided the entire growth with a wide margin of healthy tissue is removed.

The PALATE refers to the roof of the mouth, which is composed of: (A) The hard palate (Fig. 33) formed by the horizontal parts of the two superior maxillary bones, and (B) the soft palate, composed of a fold of mucous membrane lining the nasal passages and the mouth below, terminating in a pointed process, the "uvula," which hangs freely between the mouth and pharynx. Lesions include: (1) Congenital cleft. (2) Perforations.

(1) *Congenital cleft* (see Fig. 33) occurs as a result of failure of the two superior maxillary bones to unite completely. The hard palate forms by the fusion of the two superior maxillary bones 1 and 2, and a third premaxillary bone, 3. Congenital cleft palate may be double
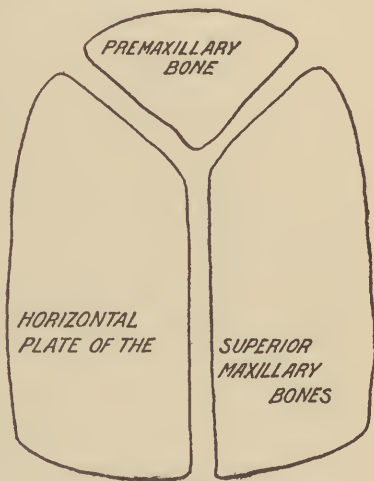
FIG. 33.—Showing the development of the superior maxillary plate and palate in relation to "cleft palate."

or single, extending into one or both nostrils, including the gum, alveolar process and the lip, and often extends as a single cleft through the soft palate. *Effects.*—(*a*) Deformity. (*b*) Interference with nursing and swallowing so that special methods of feeding, by a dropper or tube, may be necessary. Marked malnutrition may result and demand early treatment. (*c*) Interference with respiration and later with phonation. (*d*) Further separation of the cleft and contraction of the soft parts. *Treatment* is surgical repair. The preferable time is a matter of judgment but is most often done within the first few months of life. The operation is difficult, especially in

older children, but the results are usually good and the risk is slight in the hands of competent operators.   Post-operative care is most important.   Sutures are usually reinforced by adhesive straps across the cheeks.   Feeding is done by means of a tube passed through the nostril into the stomach, to avoid contamination of the mouth and wound.   Mild antiseptic solutions, boracic acid, or alkaline antiseptic mixtures are used as a spray or mouth-wash.

(2) *Perforation* of the palate occurs: (*a*) As a result of complete closure of a cleft, (*b*) accident, (*c*) syphilitic ulceration. Repair is difficult and often unsatisfactory.   Specific treatment is urgently indicated in syphilitic cases to prevent further destruction of tissue.

The TONGUE is a muscular organ attached to the lower jaw and hyoid bone.   It is covered with mucous membrane which contains the special taste cells and nerve endings, also mucous secretory glands.   Mechanically it aids in swallowing and in articulation.

(1) *Wounds* are rare, bleeding is profuse, and healing is usually rapid, wound infection being infrequent on account of the rich blood-supply.

(2) *Ulcers* occur as a result of persistent irritation from broken teeth and are associated with considerable induration, to a degree suggesting a malignant growth.   Removal of the cause is indicated, after which the condition should clear up. Syphilitic ulcers are rare, but simulate malignant growths.

(3) *Tumors.*—Benign cysts are rare, but may reach considerable size.   Enucleation of the mass, while technically difficult, is not followed by recurrence.   Malignant cancer from the mucous membrane begins as an ulcer which does not heal even when the apparent source of irritation has been removed. Extension to the submaxillary gland is early.   Prompt radical excision is indicated and is successful in a fair percentage of cases.   It is a formidable operation, consisting of complete removal of the tongue and lymph-nodes in the anterior triangle of the neck, but the mutilation is not as great as might be expected.

(4) *"Tongue-tie"* refers to an abnormally short "frenum," or the fold of mucous membrane from the tip of the tongue to the floor of the mouth.   It occurs rarely in the new-born, and is

supposed to interfere with nursing and later with articulation. Treatment, when indicated, consists of division of the frenum with scissors.

The floor of the mouth under the tongue covers the sub-maxillary and sublingual salivary glands. The principal surgical lesion is "*ranula*," a retention cyst of the salivary gland or its duct. Such a tumor may reach considerable size and interfere with movements of the tongue. Treatment: (1) Reëstablishment of the patency of the duct. (2) Excision of the mass.

The *Throat* or *Pharynx* is continuous with the mouth at the "fauces," *i.e.*, the folds of mucous membrane which extend from the uvula and soft palate to the base of the tongue. The pharynx includes: (1) The NASO-PHARYNX, above the level of the soft palate, continuous with the nasal passages in front, in the lateral wall receives the openings of the Eustachian tubes which communicate with the middle ear, and contains the masses of lymphoid tissue, the "adenoids." (2) The ORO-PHARYNX, at the level of the mouth, including the tonsils. (3) The LARYNGO-PHARYNX, below the base of the tongue, receiving the openings of the œsophagus and larynx. Lesions of interest are:

The *Tonsils*, composed of lymph tissue, are limited at the base by a definite capsule and are located between the "pillars of the fauces." Acute inflammation, *tonsillitis*, is frequent either as an independent infection, or complicating certain general infectious diseases (scarlet fever, measles, or diphtheria) and is usually due to some type of streptococcus. It is associated with constitutional symptoms, fever, toxæmia, and pain, both local and general. Duration is usually a few days. *Complications*: (1) Peritonsillar abscess, or "quinsy," occurs in some cases as a painful swelling in the peritonsillar tissues, usually of the soft palate. In favorable cases spontaneous recovery takes place in a few days, while in others suppuration develops. In this event the condition persists till spontaneous rupture or surgical incision provides drainage. (2) Cervical adenitis is not uncommon. (3) Hypertrophy and chronic inflammatory changes in the tonsil, with recurrent attacks. (4) Constitutional effects, rheumatism, acute or chronic, heart lesions. (5) Pharyngitis and chronic infection of the adenoids. This may also occur

independently of the tonsils, associated with local pain and general effects. (6) Extension through the Eustachian tube and infection of the middle ear.

Principles of Treatment.—During an acute attack of tonsilitis, treatment is confined to constitutional measures for fever, pain, and infection; and locally to applications of silver preparations, or iodine and hot gargles with mild solutions of: Salt or Alkaline antiseptic. Tonsillectomy is reserved until after the acute attack has subsided. Quinzy or peritonsilar abscess is slow in development, is accompanied by severe pain, and difficulty in swallowing. The condition commonly runs for several days or a week before one can demonstrate sufficient localization and abscess formation to justify incision. In many instances the abscess opens spontaneously before fluctuation can be well demonstrated. Treatment is limited to sedatives; Acetylsalicylic acid, phenacetin, salicylates, or combinations, external applications of heat or cold, fluid diet, local treatment.

Surgical removal of the tonsils, *Tonsillectomy*, is indicated under the following conditions: 1. Local soreness or swelling of the tonsils persisting after an acute attack. 2. History of recurrent attacks of tonsilitis. 3. Evidence of abscess or discharging sinuses in the tonsil, or local complications, adenoids, middle ear infection following from a previous attack. 4. History or evidence of constitutional sequels from tonsilar infection, recurrent inflammatory rheumatism, endocarditis, etc. In many instances the relation of the constitutional condition to buried or deepseated infection of the tonsil is remote, but none the less definite.

In the hands of competent surgeons, removal of the tonsils is comparatively simple and there are few untoward results. As commonly done with some variety of the snare and dissection, removal is complete and recurrence is exceedingly rare. Infection is never severe when a reasonable time has elapsed since the last acute activity. Injury to neighboring structures can be avoided by good light and careful distection. Hemorrhage may be considerable, but excessive loss of blood is prevented by: 1. Testing the " Coagulation time " of the patient's blood, proceeding operation and giving suitable treatment to those who show an abnormal tendency to bleed. 2. Careful dissection and prompt control of hemorrhage at the operation. For

children, general anæsthesia, ether, is commonly used in a special apparatus to carry the warm ether vapor into the pharynx. In adults local anæsthesia is usually preferred.

The *adenoids* of the naso-pharynx are frequently inflamed and hypertrophied in young children, either associated with or independent of the tonsils. The effects are: (1) Mechanical interference with normal respiration and secondary constitutional changes in development. (2) Recurrent attacks of catarrh, pharyngitis, and bronchitis. Removal is indicated for either condition, and is a simple operation.

The LOWER JAW, or inferior maxillary bone, articulates with the temporal in front of the external auditory meatus.

Dislocation forward occurs: (1) Spontaneously as a result of sudden forcible movements, yawning. (2) Sudden downward pressure on the open jaw, especially under anæsthesia, by a mouth-gag or tongue depressor. Reduction under anæsthesia is simple and may be accomplished without.

Fracture takes place most often to one side of the mid-line, and is likely to be compounded into the mouth. Reduction is usually simple, but immobilization is extremely difficult. Some form of dental appliance is necessary.

DEMONSTRATIONS.

1. The conjunctiva and openings of the tear-ducts on patient.
2. Method of removal of foreign body, reflection of lids, irrigation and instillation, application of pressure bandage.
3. History of case of sympathetic ophthalmia.
4. Cases of blindness or specific histories, with explanation of cause.
5. History of a penetrating wound of the orbit with complications.
6. Case of facial paralysis with explanation of cause and results.
7. Trifacial neuralgia.
8. Demonstration of facial artery and practice of counting of pulse in that vessel.
9. Swelling of parotid gland.
10. Demonstration of nasal septum and turbinates with a speculum, also showing anomalies.
11. Demonstration of the "accessory sinuses" on a skull cut to expose them.
12. Methods of control of nose-bleed.
13. Demonstration of ulcers of the lip, and if possible epithelioma.
14. Case of cleft-palate, showing methods of feeding preceding and following operation.
15. Demonstration of the tongue, frenum, and relations to "tongue-tie."
16. Demonstration of the tonsils and pharynx.
17. Case history of a case of tonsillitis with complications.
18. Apparatus for immobilization of fracture of the lower jaw.

CHAPTER IX

THE NECK, CERVICAL REGION

THE limits of this region are: The mastoid process and lower jaw above, and the clavicle, or "shoulder-bone," below. The structures which present surgical interest include: Superficial landmarks; blood vessels; nerves; lymph-nodes; thyroid; larynx and trachea; oesphagus; vertebral column.

A. The principal **surgical landmarks** are: (1) BONY: the spinous process of the seventh or eighth cervical vertebra, which marks the lower level of the neck posteriorly. The cricoid cartilage, or "Adam's apple," is easily palpable and forms the anterior wall of the larynx. It can be seen to move during swallowing. (2) MUSCULAR: the sterno-cleido-mastoid muscle can be seen or palpated, extending from the sternum to the mastoid process, and divides the neck into the "anterior and posterior triangles." Throughout most of its course the muscle covers the carotid arteries and the deep jugular veins. The trapezius muscle can be palpated, extending from the tip of the shoulder to the occiput of the skull, and with the clavicle and posterior border of the sterno-cleido-mastoid muscle, forms the "posterior triangle" of the neck. *Accidental wounds* of the neck are of most importance when the larger vessels or trachea are involved.

B. **Vessels.**—(1) Veins: (*a*) The superficial jugular veins are often visible, especially when the neck is compressed or there is venous congestion. *Hemorrhage* from these veins is profuse but can usually be controlled by compression, and if promptly cared for is not fatal. (*b*) The internal jugular veins accompany the carotid arteries, under the sterno-cleido-mastoid muscle. Hemorrhage from these vessels is rapidly fatal unless prompt surgical control is possible.

Thrombosis of the jugular veins is an occasional complication of the middle ear or mastoid suppuration. Surgical excision of the thrombosed vein is sometimes done to prevent septic emboli from reaching the heart and general circulation.

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(2) The CAROTID ARTERIES include the common caro-
tids and their two branches. (a) The external carotids supply the
neck, face, and scalp, and (b) the internal carotids, with the two
vertebrals, form the anastomotic "circle of Willis" and supply
the brain. The carotid vessels reach the neck under the clavicle
posterior to the sterno-cleido-mastoid muscle, pass upwards
beneath this muscle, and finally under its anterior border
behind the angle of the jaw. *Hemorrhage* from wounds of the
carotids or one of the principal branches is rapidly fatal unless
promptly controlled. *Ligation* of the external carotid is usually
compensated by collateral circulation, and may be necessary to
control bleeding from one of its branches. Ligation of the
internal or common carotid is often followed by serious dis-
turbance in the cerebral circulation, evident by faintness or
temporary unconsciousness, but is rarely fatal.

C. **Nerves.**—1. SPINAL ACCESSORY, the "eleventh cranial"
nerve to the trapezius muscle, crosses the posterior triangle of
the neck. It is sometimes cut in operations for the removal
of enlarged adherent lymph-nodes. There follows a paralysis
of the dependent muscle, with characteristic shoulder-drop
and inability to raise the shoulder or arm above that level.

(2) The VAGUS, "pneumo-gastric" or "tenth cranial" nerve,
passes through the neck under the carotid and jugular vessels.
Accidental injury is rare, but pressure on the nerve from tumors
or aneurism may cause marked disturbance in the circulation.
The recurrent laryngeal branches of the vagus to the vocal
cords pass in close relation to the thyroid gland. It is occasion-
ally injured in operations on that gland, resulting in paralysis of
the corresponding vocal cord.

(3) The BRACHIAL PLEXUS (see Fig. 28) of the spinal nerves
to the upper extremity crosses the lateral region of the neck.
Parts of it may be severed or torn as a result of: (a) Injury
during birth. (b) Stab or gunshot wounds. (c) Severe
wrenching of the arm. There results a permanent paralysis
and disturbance of sensation involving definite portions of the
upper extremity. After the extent of permanent disability
has been determined, surgical exposure and suture of the sev-
ered nerve trunks is indicated and feasible.

D. **Lymph-nodes.**—Superficial and deep chains of nodes
extend in both the anterior and posterior triangles of the neck,

the deep chain being in close relation to the large vessels. The cervical lymph-nodes receive the lymphatic drainage from the scalp, ears, face, teeth, tonsils, and neck, and also communicate with the axillary and thoracic chains. They may therefore be involved secondarily, in infectious or malignant processes, in any of the above tributary areas.

INFECTIONS may be: (1) Acute inflammation of the cervical lymph-nodes is caused most often by superficial abscess, or infection about the mouth, teeth, or throat, as in tonsillitis, scarlet fever, or measles. The effects are the same as lymph-node involvement in general. (See page 97.) Possible results are: (a) The process gradually subsides without suppuration, provided the original focus is self-limited or is controlled by treatment. (b) The involvement of the lymph-nodes goes on to suppuration and extends to adjacent tissues, resulting in a diffuse abscess which must be treated independently of the original focus.

Principles of Treatment.—(i) Measures to control the original focus of infection. (ii) Constitutional treatment of the fever and sepsis. (iii) Local application or an ice-bag, to the involved region. (iv) Surgical incision and drainage when suppuration is evidently present.

(2) Chronic inflammation includes: (a) Tuberculosis, and (b) Hodgkin's disease.

(a) TUBERCULOSIS (see page 36) of the cervical glands may develop from a portal of entry in the area of drainage (mouth or throat), or secondarily to a pulmonary lesion, either of which may have been unrecognized. It occurs most often in children or young adults, and the development is insidious. There is often constitutional evidence of tuberculosis, but the patients are often well nourished. The nodes are enlarged, and, in the early stage, discrete. Suppuration occurs later, often being due to secondary infection, and there results a diffuse mass of densely adherent lymph-nodes. The course is chronic, extending over a period of months, and recurrence is frequent.

Principles of Treatment.—(i) Constitutional and specific therapy for tuberculosis. (ii) Local, incision and drainage is reserved as a last resort, on account of the danger of secondary infection and persistent sinus. Radical dissection of the entire mass of nodes is sometimes done in selected cases.

(b) HODGKIN'S DISEASE is a chronic inflammatory process involving the lymph-nodes, especially in the cervical region, caused by a specific micro-organism.   The onset is insidious, and the portal of entry is often obscure.   There is marked enlargement of the lymph-nodes with characteristic microscopic changes.   Suppuration is rare.

Principles of Treatment.—(i) Constitutional and specific by serums or vaccines.   (ii) Surgical removal of the enlarged lymph-nodes

(c) MALIGNANT GROWTHS in the area drained by the cervical lymph-nodes is soon accompanied by moderate enlargement of these structures.   The nodes are palpable and discrete.   Microscopical examination of an excised node demonstrates the presence of metastatic growth of the tumor. *Significance.*—(1) The early extension of all malignant growths to these nodes is an indication for the radical dissection of the cervical lymphatics in all operations for malignant disease in the tributary area. (2) The actual presence of enlarged nodes in a given case is evidence that the growth is no longer local, and gives a less favorable prognosis.

E. **The Thyroid gland** is a glandular structure consisting of two lobes, one on each side of the trachea, covered by the sterno-hyoid muscles, and connected by a narrow portion, or the "isthmus," which crosses in front of the trachea.   The gland develops embryologically as an out-growth from the floor of the mouth in the region of the "foramen cæcum," at the base of the tongue. This connection is normally lost early in development, but the origin explains the occasional development of masses of aberrant thyroid tissue higher in the neck, or in the base of the tongue. *Function:* The thyroid furnishes an essential internal secretion which controls development during childhood, and influences body-metabolism throughout life.

Abnormalities in Function.—1. ATHYROIDISM, "cretinism," is due to congenital absence of functioning thyroid tissue and is characterized by dwarfed stature, mental deficiency or idiocy, typical over-development of subcutaneous tissue, and thickened skin.   2. MYXEDEMA HYPOTHYROIDISM, due to deficient thyroid secretion may be: (a) Congenital, (b) develop spontaneously at any age, or (c) follow extensive loss of thyroid tissue by disease or operation.   The results vary in degree and include mental

changes, depression, sluggishness or semi-stupor; the circulation is poor and the extremities are easily chilled, the subcutaneous tissues are overdeveloped, with thickening of the skin, and a characteristic wooden, immobile expression of the face. The condition is obscure in development and is easily overlooked. *Treatment* is specific, *i.e.*, feeding thyroid extract in proper doses, and gives striking results. Spontaneous readjustment may occur during treatment, but in some cases the feeding must be continued indefinitely. 3. HYPERTHYROIDISM, due to the absorption of an excessive amount of normal or abnormal thyroid secretion, is known as "exophthalmic goiter" (see later).

Goiters or enlargements of the thyroid include four groups: (1) Simple hypertrophy; (2) simple goiter; (3) toxic goiter, and (4) malignant growths.

(1) Simple general hypertrophy of the thyroid often occurs as a compensatory process to meet unusual demands for thyroid secretion, particularly during puberty or pregnancy, also less often in the male at puberty. Since the condition is compensatory and self-limited, treatment is usually not indicated.

These goiters are not infrequent and may be a source of alarm to the patient or her family. As a rule one may give assurance that the condition will subside spontaneously. Should it persist or increase, or should constitutional symptoms develop, competent surgical advice should be obtained.

(2) SIMPLE GOITERS include a variety of pathological changes such as atypical development, cystic or colloid degeneration. The enlargement may be definitely limited and encapsulated, or more diffuse. The simple goiters cause only mechanical effects from pressure on neighboring structures. Example: On the trachea, causing dyspnoea, or asthma. In some cases it may undergo changes and give rise to toxic symptoms resembling the early stage of exophthalmic goiter. There is often marked enlargement and deformity, also extension of the growth to the thoracic cavity causing serious compression of the trachea or great vessels. *Treatment.*—Non-surgical measures, local or constitutional, if closely supervised may be of considerable value. The use of iodine either locally or internally as frequently advised may cause serious effects and

is to be used only under the direction of the surgeon. Surgical removal of localized tumors or partial thyroidectomy is indicated in case of: (a) Excessive growth and deformity. (b) Serious pressure symptoms. (c) Evidence of extension to the thorax. (d) Toxic effects.

(3) TOXIC GOITER, EXOPHTHALMIC GOITER, or "Graves' disease," is characterized by a group of symptoms due to the absorption of an increased amount of thyroid secretion, or possibly, an abnormal secretion due to degeneration of a goiter. The picture may be only partial, or complete, including: (a) Circulatory changes, "tachycardia," rapid heart-beat, 120 to 150, later cardiac murmurs, dilation and irregular pulse. (b) Nervousness and irritability: flushing of the face, and characteristic tremor of the hands. (c) Eye changes, "exophthalmos," prominent, protruding eyeballs; failure of the upper lid to completely close. (d) Gastro-intestinal symptoms: vomiting and diarrhœa in severe cases. The course is usually progressive, with remissions. Improvement and cure may follow judicious medical treatment: rest-cure, sedatives, and avoiding all irritation and nervous factors. *Surgical treatment* is indicated in persistent cases, or those not influenced by careful medical measures. It includes: (1) Ligation of one or more of the thyroid arteries to cut off part of the blood-supply. (2) Partial thyroidectomy.

(4) MALIGNANT growths, usually cancer, occur in older individuals and are characterized by rapid diffuse growth, and early pressure effects.

F. **Larynx and Trachea.**—The LARYNX is composed of several cartilages, including the prominent "cricoid" cartilage, or Adam's apple. It contains the vocal cords, is continuous with the trachea below, and opens to the pharynx above. The "epiglottis" cartilage protects the opening of the larynx and prevents food and saliva from entering the larynx or trachea. Surgical interest includes: (1) Occlusion of the larynx by foreign bodies. (2) Inflammation, œdema, or membrane. (3) New-growths.

1. FOREIGN BODIES may be aspirated during anæsthesia or unconsciousness, or by sudden inspiration while swallowing. They may lodge in the larynx or pass into the trachea. If located in the larynx, they are often expelled by coughing, or inversion of the patient. When the opening is entirely occluded,

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strangulation is imminent, and tracheotomy is indicated as an emergency.

(2) ŒDEMA OF THE GLOTTIS, *i.e.*, of the membrane lining the larynx and vocal cords, is an occasional complication of inflammatory conditions about the throat, burns, or inhalation of irritating gases. The condition may develop gradually and give warning by difficult breathing or "croupy attacks." In some instances the œdema is rapidly progressive, and sufficient to occlude the larynx, threatening strangulation.

Principles of treatment include: Relief of the causal condition, the use of sprays or inhalation of astringents, adrenalin, steam with paregoric or camphor, and intubation or tracheotomy in urgent cases.

Intubation consists of the insertion of a hollow silver tube through the partially occluded larynx, by means of special apparatus. The procedure requires an expert and is not always successful. "Membranous croup," which is usually diphtheritic, is a common cause of laryngeal obstruction. It may occur in neglected cases of diphtheria, or apparently as the initial symptom of the disease. Prompt recognition of the condition is important, and specific treatment with large doses of antitoxin is urgently indicated. In all cases where there is any suggestion of laryngeal obstruction arrangements must be made to have immediate access to proper instruments for intubation and tracheotomy, and to an expert operator.

The *vocal cords* consist of musculo-membranous folds extending across the larynx. They are supplied by the recurrent laryngeal branch of the vagus, which may be irritated or injured by: Thyroid tumors, aneurisms, or operation, resulting in hoarseness, or aphonia, and paralysis of the corresponding cord.

(3) TUMORS: (1) Benign polyps interfere with the voice, cause hoarseness or aphonia, and are discovered by special examination. They may be removed through the mouth and pharynx, or in special cases by external exposure through the larynx. (2) Malignant growths, epithelioma, if recognized early, may be removed by radical excision of the larynx with a fair prognosis for permanent cure.

The **Trachea** or "windpipe" is continuous with the larynx above, extends through the anterior region of the neck, under the sternum, where it divides into the right and left bronchus,

which pass to the corresponding lung, subdividing into smaller bronchi and bronchioles. It is lined with ciliated epithelium and is further composed of a dense fibrous membrane reinforced by a series of cartilaginous rings which protect the lumen from collapse or compression.

Points of surgical interest: (1) Injury. (2) Pressure. (3) Occlusion. (4) Tracheotomy.

(1) EXTERNAL INJURY.—Wounds opening into the trachea are not necessarily fatal. *Dangers:* (a) Collapse of the trachea. (b) Occlusion by blood-clots, and strangulation. (c) Infection, and septic pneumonia. (d) Suppuration of surrounding tissues, extending to the thorax and mediastinum.

(2) COMPRESSION by external violence may fracture the cartilage rings or cause swelling of the mucous membrane, possibly with complete occlusion. Since the trachea is loosely attached to the surrounding structures, it may be forced to the side and often escapes serious injury. Pressure from tumors, usually of the thyroid, if unilateral, causes deviation of the trachea with more or less occlusion of the lumen. Bilateral compression results in marked narrowing of the lumen, causing difficult respiration and a tendency to asthma.

(3) ASPIRATION of foreign bodies which pass the larynx results in occlusion of the trachea or one of the bronchi, with strangulation if the trachea is involved; or if one of the bronchi is occluded, the dependent portion of the lung is thrown out of function, resulting in gangrene or abscess. Removal of the foreign body is sometimes possible through the larynx by means of special instruments in the hands of experts. In urgent cases tracheotomy is necessary.

(4) "TRACHEOTOMY" is the operation of making an artificial opening into the trachea to permit free respiration. It is done: (a) In emergencies, when the larynx or trachea is occluded and everything is sacrificed to obtain instant relief. (b) As a preliminary to extensive operations about the mouth. Provision must be made for some means of maintaining the opening in the trachea, and to prevent the aspiration of blood or mucous. The dangers are those of external wounds of the trachea: (i) Collapse of the trachea, and failure of respiration. (ii) Aspiration of blood or mucous with strangulation, or later septic pneumonia. (iii) Infection of surrounding tissues, especially

when the tracheotomy is made low in the neck, and extension
to the mediastinum.

G. The Œsophagus or "gullet" extends from the pharynx
behind the trachea and is thus protected from external injury.
It can be exposed surgically in the neck. Surgical interest is
limited to: (1) Injury and strictures from swallowing foreign
bodies, irritating caustic substances. (2) Ulcers. (3) Cancer.

1. FOREIGN BODIES which reach the œsophagus usually
pass into the stomach or can be forced there by a tube, under
anæsthesia. In case one is lodged in the gullet, there is danger
of ulceration and rupture to the mediastinum. Removal is
usually possible through external exposure in the neck. Caus-
tics and irritating substances, including acids and strong alkalis,
may be swallowed accidentally, or with suicidal intent.

The results are: (a) Ulceration which may penetrate to
the mediastinum. (b) Stricture from the healing of such an
ulcer. (i) Permeable strictures permit the passage of fluid, and
can usually be dilated by suitable means, and do not present
immediate danger of starvation, though further narrowing may
occur. (ii) Impermeable stricture does not allow the passage
of fluids or small sounds. Starvation is imminent unless the
condition can be improved or nutrition can be supplied by
other channel, rectal feeding, or gastrostomy wound.

Dilatation of the gullet above a stricture may reach consid-
erable size, and is characterized by the regurgitation of food or
fluids. X-ray examination after taking bismuth mixtures dem-
onstrates the condition. *Principles of treatment:* (a) Relief of
irritation of the stricture or ulcer by withholding food by
mouth. (b) Rectal feeding. (c) Gastrostomy in more pro-
longed cases. (d) Dilatation by the use of sounds or hydro-
static pressure.

2. INFLAMMATORY ULCERS, except those due to irritating
substances, are rare.

3. MALIGNANT DISEASE is usually cancer, resulting in ulcera-
tion and stricture formation, which finally becomes impermeable.
Palliative measures include rectal feeding and gastrostomy.
Surgical removal is exceedingly formidable.

H. The cervical portion of the Vertebral column presents
the following surgical lesions: (1) Cervical rib. (2) Fracture
and dislocation. (3) Disease.

1. CERVICAL RIB, an incomplete rib attached to the last cervical vertebra, occurs as a rare congenital anomaly. It is usually unilateral, and may or may not be attached to the sternum. Effects: Pressure on the brachial plexus with motor or sensory disturbance in the upper extremity. Also, pressure on the axillary vessels, possibly causing an aneurism. Surgical removal is often advised.

2. VERTEBRAL FRACTURE and dislocation occur associated as the result of violence. Pressure on the cord causes serious disturbance, and the result is likely to be fatal. In rare cases exposure, with reduction, is possible.

3. DISEASE, usually tuberculosis, "Pott's disease," may involve the cervical region. Deformity is marked with serious pressure on the spinal cord. "Retro-pharyngeal abscess" is a serious complication because of the danger of spontaneous rupture into the pharynx, with strangulation or septic pneumonia.

DEMONSTRATIONS

1. Demonstration of bony and muscular landmarks of neck on a model or patient.
2. Demonstration of the arteries of the neck and the "circle of Willis" on an anatomical chart.
3. Case demonstration showing paralysis of the spinal accessory nerve.
4. Case showing acute cervical adenitis with explanation of cause.
5. Case of tubercular cervical adenitis.
6. Case or illustration of Hodgkin's disease.
7. Cancer of the face, tongue or lip, with involvement of cervical glands.
8. Case or illustrations showing cretinism, and myxodema.
9. Cases or histories illustrating various forms of goiter.
10. Demonstration of the parts of the larynx on model or charts.
11. Methods of treating laryngeal obstruction.
12. Apparatus for intubation, technique of after-care.
13. Instruments for tracheotomy and care of wound.
14. X-ray plate showing stricture of the œsophagus with dilatation above.
15. Sounds and apparatus for dilatation of stricture of œsophagus.
16. X-ray plate showing cervical rib.

THE THORACIC CAVITY AND BREAST

THE THORAX is composed of: (1) Twelve "thoracic or dorsal" vertebræ. (2) Twelve pairs of ribs: (a) Six pairs of "true ribs" attached directly to the sternum; (b) four pairs of ribs attached by cartilage to the sternum, and (c) two pairs of "floating ribs" which are unattached at their anterior ends. (3) The sternum, or "breast-bone." The contents are: the trachea and bronchi, the lungs and pleural cavity, the great vessels, the heart and pericardium, the œsophagus, and mediastinum.

A. **Bony Framework.**—1. VERTEBRAL COLUMN. (a) Fracture with dislocation of fragments occurs as the result of violence involving especially the spinous process or part of the neural arch. The effects are pressure or injury to the cord. (See page 111.) *Treatment:* In selected cases it is possible to expose the site of fracture by surgical operation, "laminectomy," and relieve pressure. (b) Disease of the vertebræ is practically limited to tuberculosis. The bodies are most often involved, resulting in characteristic deformity, "kyphosis," often with "scoliosis." *Treatment:* Immobilization with cast or apparatus. *Scoliosis*, lateral curvature of the spinal column due to faulty position, either standing or sitting, is not infrequent in young adults. It may result in serious deformity of the chest and impairment of general health. The condition calls for proper treatment: orthopædic apparatus or gymnastic exercise, and correction of the predisposing factors.

2. RIBS.—Fracture is caused by compression or blows on the sternum: (a) Indirect violence resulting in a green-stick fracture at the point of greatest curvature, *i.e.*, in the axillary line. (b) Direct violence and depressed fracture associated with injury to the lungs or pleura. Fractures are most often simple. Evidences: Sharp local pain which is increased by coughing or deep breathing, also marked local tenderness. *Principles of treatment:* Immobilization by tight strapping with adhesive bandage to

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prevent motion during respiration.   To be efficient it must
relieve all pain.

3. STERNUM.—Fracture occurs rarely, as the result of
crushing injury or direct violence.   Marked displacement may
cause serious disturbance to underlying structures.   Immobili-
zation is difficult.   Surgical measures may be necessary to raise
depressed fragments.

Penetrating wounds of the thorax include gunshot and stab
wounds.   These are often deflected by bony parts and remain
superficial instead of penetrating.   Wounds which involve the
great vessels are usually promptly fatal.   In exceptional cases,
certain wounds of the ventricles or pericardium can be exposed
surgically and sutured in time to save life.   Penetrating wounds
of the lungs are characterized by: Pain, cough, expectoration of
blood.   Later there is hæmothorax, *i.e.*, collection of blood in
the pleural cavity.   If not immediately fatal, these collections
are often absorbed in the course of a few weeks with but
slight permanent effect.   The treatment is usually expectant,
"aspiration" or exploration being indicated in special cases.

B. **The trachea** and **bronchi** have been considered in the
preceding section (pages 146, 147).   Tumors or masses in the
mediastinum cause serious compression of the trachea, and
disturbance of respiration.

C. **The Lungs and Pleural Cavity.**—Surgical lesions of the
lungs are rare.   Gangrene, followed by lung abscess may be
caused by: (1) Occlusion of a bronchus.   (2) Thrombosis or
embolus in a branch of the pulmonary artery.   There is evi-
dence of sepsis, and some local physical signs.   Surgical treat-
ment by excision or drainage is rarely feasible as the condition
is usually fatal.

The PLEURAL CAVITY (see Fig. 34) on each side contains the
lungs and is lined by the "pleura," a serous membrane composed
of two layers: (a) *Visceral pleura*, which is attached to the lung
and extends between the lobes to the roots of the bronchi, where
it is reflected as (b) the *parietal layer*, adherent to the costal
walls and diaphragm.   The pressure within the pleural cavity
is constantly lower than that within the bronchi and lungs,
and also than that of the exterior atmospheric pressure.

1. PNEUMOTHORAX (see Fig. 34) is a condition where the
intrathoracic or pleural pressure is equal to the exterior or

atmospheric pressure. It may be: (a) External, due to extensive accidental wounds or operative openings. (b) Internal, due to perforation of a dilated bronchus or lung abscess into the pleura. *Effect:* The increased intrapleural pressure causes collapse of the lung on the side involved and prevents normal expansion during lung inspiration. The lung is thrown out of function and if the
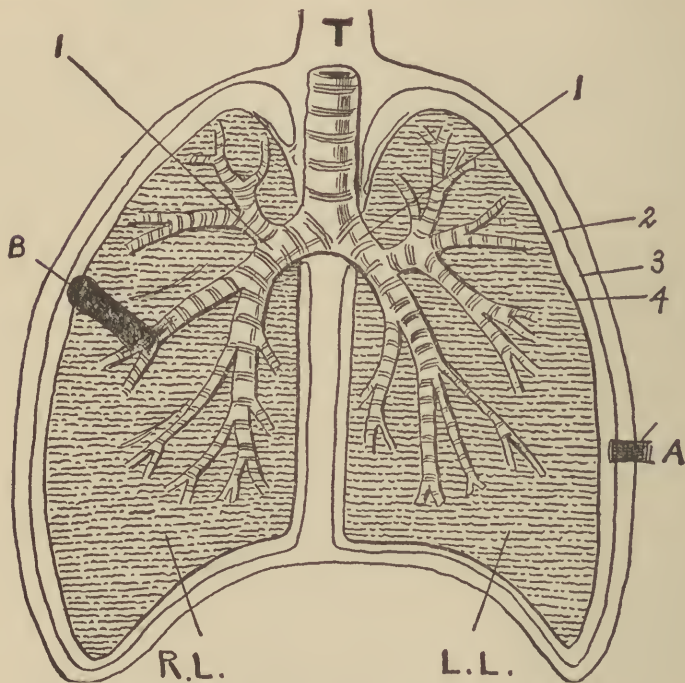
FIG. 34.—Diagram showing the pressure relations in the thoracic or pleural cavity, and lungs. *T*, trachea; *R. L.* and *L. L.*, right and left lungs; 1, bronchi and pulmonic cavity continuous with the exterior; pressure equal to atmospheric; 2, pleural cavity between; 3, parietal and 4, visceral pleura. Pleural pressure is constantly less than pulmonic and atmospheric. It is increased during expiration and causes collapse of the lungs. It is decreased during inspiration and allows expansion of the lung by the external atmospheric pressure. *Pneumothorax* is an artificial communication between the pleural space and the atmospheric pressure. *A*, external, or *B*, internal. Results, increased pressure in the pleural cavity and collapse of the lung.

condition is bilateral, respiration is impossible unless maintained by artificial means. (See Physiology.) Simple wounds

which are promptly closed cause only temporary disturbance and normal pressure relations are soon re-established.

2. SURGICAL LESIONS.—(a) *Pleurisy.* Inflammation of the pleura occurs: (i) Complicating or following pneumonia. (ii) As an independent lesion. It may be "dry," characterized by severe pain in breathing or coughing, and typical physical signs. Local treatment consists of immobilization by tight strapping with adhesive and an ice-bag.

(b) *Pleural effusion, i.e.,* an exudate of serous fluid into the pleural cavity, may (i) complicate pleurisy; (ii) occur as a result of heart disease with "broken compensation." The effects are: Mechanical interference with respiration, cough, dyspnœa, distress, or pain which is increased by cough and deep inhalation. There is sometimes displacement of the heart and disturbance in circulation. Characteristic physical signs can usually be demonstrated.

Principles of Treatment.—"Aspiration," *i.e.,* withdrawal of the fluid by means of a hollow needle introduced between the ribs into the cavity, is commonly done. The principal danger is, occasional shock or syncope from the sudden aspiration of a large amount of fluid. The procedure is carried out under strict asepsis. It is also done for diagnosis, *i.e.,* to determine the character of the fluid present, especially when suppuration is suspected.

3. EMPYEMA refers to a collection of pus in the pleural cavity, which occurs as a sequel to pneumonia or pleurisy. The effects are: (i) Mechanical as in pleural effusion, and (ii) sepsis.

Principles of Treatment.—Surgical incision and drainage are indicated when the presence of suppuration is determined, and are obtained by the resection of one or more ribs. In some cases antiseptic solutions (formalin in glycerin) are introduced into the cavity. Persistent after-care, special breathing exercises are used to encourage the expansion of the contracted lung and obliteration of the cavity.

D. The **great vessels**, aorta, vena-cava, and pulmonary vessels, may be seriously affected by pressure of intrathoracic tumors, causing disturbance in the dependent circulation. Aneurism of the aorta or its branches gives local pressure effects, pain, local and referred, and presents constant danger of rupture with fatal hemorrhage.

E. Heart and Pericardium.—The heart presents surgical lesions only in case of certain penetrating wounds involving the ventricles, which may be reached and sutured by prompt surgical incision. The *pericardium* is a serous cavity surrounding the heart, similar in structure to the pleura and peritoneum. Pericardial effusion or empyema occurs as a result of inflammation and causes marked disturbance in the heart-beat and circulation. The condition is obscure and recognition is difficult. Aspiration of pericardial fluid may be accomplished with beneficial results, and the cavity can be explored through suitable surgical exposure.

F. The Œsophagus has been considered on page 148.

G. The Mediastinum refers to the space between the right and left lungs and contains: The thymus gland, pulmonary lymph-nodes, trachea and œsophagus, great vessels, and below, the heart and pericardium.

The THYMUS is a gland of internal secretion, most active in children, and later atrophies. Hypertrophy occurs occasionally in infants, causing respiratory disturbance and in rare cases, sudden death. A Röntgen ray plate will usually demonstrate the enlarged thymus and should be taken in all cases where there is any suspicion. A few treatments, exposure to the X-ray usually gives relief. Enlarged thymus is an apparent cause of certain deaths occurring under surgical anæsthesia. Tumors are rare, but the pressure effects are similar. Such conditions are frequently recognized only at autopsy. The pulmonary lymph-nodes may undergo enlargement and hypertrophy secondary to pulmonary infection, or as an extension from adjacent groups. In marked cases there may be serious pressure effects. Surgical treatment is rarely, if ever, possible. Sepsis in the mediastinum is usually rapidly fatal, since it is inaccessible to surgical relief. It may be caused by suppuration of lymph-nodes, ulceration and perforation of the œsophagus, and as extension from the neck.

The breast or mammary gland (Fig. 35) develops from the surface epithelium and is located in the subcutaneous tissue under the skin of the thorax.

A. The **Nipple** is a protrusion of pigmented skin and receives the ducts of the twelve or fifteen lobes of the breast. The "areola" is a pigmented area surrounding the nipple, and contains numerous sebaceous glands which are considerably

hypertrophied during pregnancy. Both the nipple and areola show heavier pigmentation during pregnancy.

Lesions of the Nipple: (1) Malformation. (2) Fissures. (3) Discharge. (4) Malignancy.

(1) MALFORMATIONS: (*a*) Supernumerary nipples with or without corresponding breast tissue occur occasionally on one or both sides as a congenital anomaly. They may be located above the normal nipple or below it in the axilla. Removal is indicated only for hypertrophy or tumor formation. (*b*) Deformity or retraction of the nipple may be congenital. The
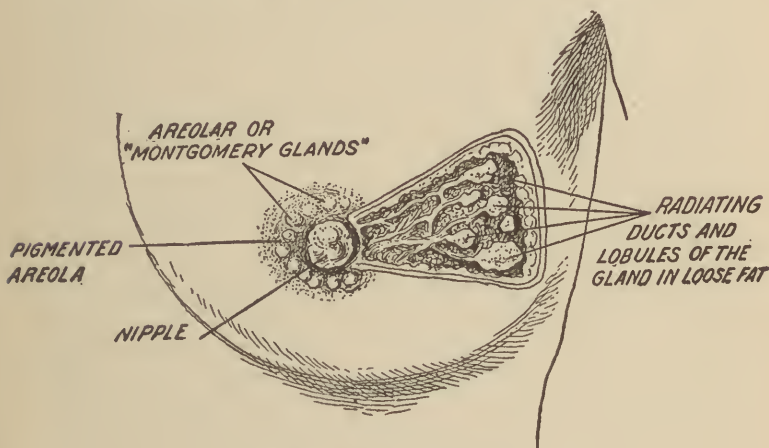
FIG. 35.—Mammary gland.

development of such a condition, especially during middle age, is suggestive evidence of cancer.

(2) FISSURES or cracks develop from irritation during lactation. These are painful, bleed during nursing, and serve as a portal of entry leading to breast abscess. Treatment is prophylactic: Care of the nipples during pregnancy, cleanliness during nursing, and the use of ointments or applications. The breasts are pumped, nipple shields used, or nursing discontinued. The chief danger is the development of breast abscess.

(3) DISCHARGE from the nipple, except during pregnancy or lactation, especially a bloody discharge, is strong evidence of malignant growth.

(4) MALIGNANT DISEASE, "Paget's disease," is a rare eczematous-like condition about the nipple and is considered as an early form of cancer.

B. The **Breast** is composed of from twelve to fifteen glandular lobes, each having a separate duct leading to the nipple. Supernumerary masses of breast tissue are less frequent than extra nipples, but occasionally occur in the axilla. They are most evident during early lactation, but true hypertrophy or secretion rarely occurs and no treatment is indicated.

Surgical lesions include: (1) Infections. (2) Tumors.

(1) INFECTIONS.—Mastitis. (*a*) *Acute infection* or abscess occurs only during lactation, usually through cracks or fissures of the nipple. There is marked swelling more or less limited, pain, later redness, and fluctuation, with constitutional reaction, fever, possibly with chill, and headache.

Principles of Treatment.—Catharsis and measures to eliminate other causes of persisting fever. Locally: firm bandage; ointments: belladonna or mercury. Massage is contraindicated since it is useless and is likely to spread the infection. An ice-bag serves to relieve pain. Surgical incision under anæsthesia is indicated as soon as suppuration is evidently present: (i) To relieve toxic symptoms. (ii) To alleviate pain. (iii) To prevent extension and unnecessary destruction of tissue. Drainage must be adequate since recurrence is not infrequent. There is rarely permanent interference with the future function of the breast.

(*b*) *Chronic breast* infection, usually tubercular, bears no significant relation to previous acute infection. The condition is rare and usually secondary to tuberculosis in other parts of the body. There is gradual development of a hard, diffuse swelling of the breast, with later enlargement of the axillary lymph-nodes. Malignant disease is often suspected.

Treatment is surgical, radical removal of the breast and tributary lymph-nodes, followed by prolonged constitutional treatment.

(2) Breast TUMORS include a variety of pathological new-growths: adenoma, adeno-fibroma, cysts, carcinoma, and rarely, sarcoma. Practically, the most important classification is: (*a*) Clinically benign. (*b*) Doubtful. (*c*) Malignant.

(*a*) Clinically benign are those about which there is not

the slightest doubt. (i) The mass is definitely circumscribed, but they may be multiple. (ii) It is movable under the skin and over the underlying structures. (iii) Individuals under thirty. (iv) Absolutely no evidence of malignancy.

(b) Doubtful tumors are those which cannot be classed clinically as absolutely benign, but show no positive evidence of malignancy.

(c) Clinically malignant tumors occur most often in women over forty but have been found under thirty. Evidences of malignancy include: (i) Diffuse, irregular masses. (ii) Fixation to the skin or to underlying structures. (iii) Rapid increase in size. (iv) Retraction of the nipple. (v) Discharge from the nipple other than that of lactation, especially a bloody discharge. (vi) Pain. (vii) Enlargement of the axillary lymph-nodes.

Principles of Treatment.—(a) Clinically benign tumors about which all possible question of malignancy can be excluded by a competent surgeon may be treated expectantly. Removal of the tumor is indicated: (i) On account of size or deformity, and (ii) to exclude possibility of future malignancy. This may be accomplished by plastic operation with little or no mutilation of the breast. Multiple tumors, or those involving both breasts, are often left till after the child-bearing period. In case of the slightest doubt radical removal of the breast and dissection of the axilla is indicated without delay.

(b) Doubtful tumors which for some reason are not positively benign, are most often treated as malignant, in which case the prognosis is good. Statistics show that a series of a given type of malignant growth, removed by radical operation at a stage when they were clinically doubtful or benign, resulted in from 70% to 100% of cures. A series of the same type of growths removed by radical operation after there was positive clinical evidence of malignancy, gave only from 40% to 60% of cures. We must remember that a new-growth in the breast which shows even the slightest positive sign of malignancy has already passed the early stage and the most favorable opportunity for successful removal with freedom from recurrence or metastases. Really early removal while the growth is still clinically benign or doubtful gives a favorable prognosis, if done successfully, with but little deformity, mutilation, or loss of function. When advised by a competent surgeon, the operation

should be accepted at once and without question, as delays are dangerous.

When an expectant course is advised it should be confirmed by consultation and the patient kept under close observation   *Danger signs* include: growth of the tumor, pain, discharge from the nipple, changes in the nipple or skin.

Exploration of the tumor for diagnosis, by gross appearance or frozen section, to be followed by proper operation at the same sitting, is sometimes done in doubtful cases, but is not a safe procedure.

Radical operation consists of amputation of the breast with the pectorial muscles and lymphatics of the axilla, and a suitable plastic operation. This is sometimes done with the electro-cautery.

(c) Positive evidence of malignancy is indication for prompt radical operation, but gives only a fair prognosis.   Contra-indications: (i) Evidence of metastases.   (ii) Extensive involvement of the tributary lymph-nodes.   (iii) Constitutional effects, cachexia or malnutrition.

Other forms of treatment: Radium or Röntgen rays are of value, and indicated (i) following radical removal to prevent recurrence, and are commonly advised.   (ii) Inoperable growths. While apparent cure has been obtained in certain cases, prompt radical operation is indicated in all but frankly inoperable cases, since there is danger that extensive growth may occur while the patient is under observation.

DEMONSTRATIONS

1. Demonstration of the bony landmarks of the thorax.
2. Various deformities of the vertebral column; kyphosis, lordosis, scoliosis.
3. Method of strapping the chest for fractured rib or pleurisy.
4. Demonstration of negative thoracic pressure with bottle and rubber bag.
5. Study of smears and cultures from empyema.
6. Apparatus and technique of aspiration of the plural cavity.
7. Study of a special case history of empyema.
8. Demonstration of apparatus and method of special breathing exercises after empyema damage. Methods of "Closed Treatment of Empyema."
9. An X-ray plate showing enlarged thymus.
10. Demonstration of the nipple and areola of pregnancy, supernumerary nipple.
11. Fissures and "cracked nipple."
12. Case of breast abscess or study of history and temperature chart.
13. Method of applying binder to the breasts.
14. Cases showing various types of breast tumor.
15. Special statistics showing the comparative results of early and late radical operation for cancer of the breast.

CHAPTER XI

THE ABDOMINAL CAVITY, WALLS, AND PERITONEUM

THE abdominal cavity is limited above by the diaphragm, and below is continuous with the "pelvic cavity," to the levator ani muscle and the muscular floor of the pelvis. The "true pelvis" is surrounded by the sacrum and innominate bones, but the cavity is practically continuous with that of the abdomen.

The abdominal walls include: the vertebral column, and deep muscles of the back posteriorly. The upper lateral wall is composed of the lower ribs and their cartilages, and below the lateral muscles, the external and internal oblique and transversalis muscles together with their fascia and aponeurosis, and the rectus abdominis compose the lateral and the anterior walls. (See Anatomy.) These lateral muscles are continued forward as fascia or aponeurosis and pass to the midline to the "linea alba," which is formed by a fusion of the fascia from each side. The dense "sheath of the rectus" is formed by the aponeurosis of the oblique and transversalis muscles. The rectus muscle extends from the sternum to the symphysis pubis. The anterior wall of the abdomen is divided into nine regions by two perpendiculars (see Fig. 36), "nipple" or "mid-clavicular" lines, and by transverse lines (a) through the twelfth ribs, and (b) through the crests of the iliac bones. These regions are: the right and left hypochondriac and epigastric, the right and left lumbar and umbilical, the right and left iliac, and hypogastric.

Lesions of the abdominal walls include: (A) Relaxation. (B) Wounds. (C) Hernia. The muscles and fascia maintain the intra-abdominal pressure and thus serve indirectly to support certain of the solid organs, liver and kidneys, in their normal position. They are also important in respiration and in certain functions: vomiting, defecation, and parturition.

A. **Relaxation** of the walls may be caused by: (a) Congenitally weak muscles; (b) lack of exercise; (c) wasting disease;

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(d) following rapid or repeated distention of the abdomen from pregnancy or ascites. *Effects:* (a) Lack of support to and "*ptosis*" or prolapse of abdominal organs: kidneys, stomach, or colon. (b) Constipation and secondary results. (c) Inefficient expulsive efforts during parturition.

Principles of treatment include: Exercises to develop the muscles, general tonics, special supports and corsets. Surgical
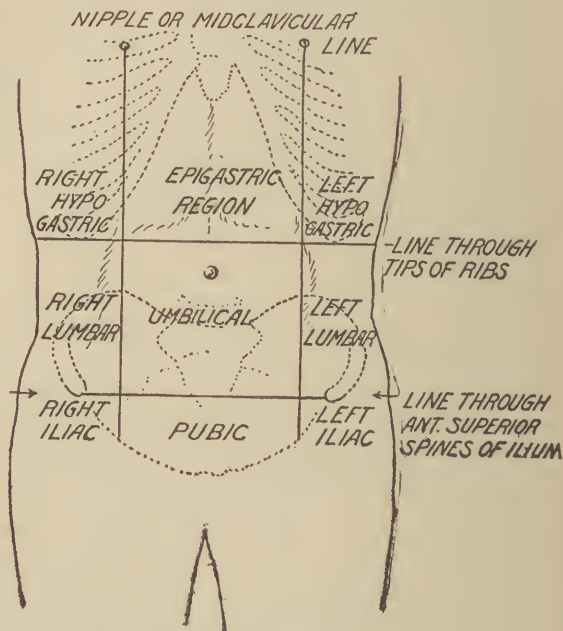
FIG. 36.—Divisions of abdomen.

operations to correct the position of displaced organs are indicated in selected cases, but recurrence of the condition is not infrequent.

B. **Wounds** of the abdominal wall may be (1) accidental, and (2) operative.

(1) ACCIDENTAL WOUNDS.—(a) Crushing injury may cause: (i) Rupture of abdominal muscles and subsequent hernia. (ii) Hemorrhage into the tissues, hæmatoma, and possibly sepsis. (iii) Injury to solid organs (liver, spleen, or kidneys), with se-

rious intra-abdominal, concealed hemorrhage, which may be
fatal. (iv) Rupture of hollow organs (stomach or bladder),
especially if they are distended. Surgical measures are indicated
in certain cases.

(b) Penetrating wounds, stab or gunshot, result in slight
injury to the abdominal wall which, in itself, is not serious. The
most significant effect is peritonitis, which is not infrequently
fatal. (See page 168.) This may be caused by: (i) Contami-
nation from the skin or surface; (ii) penetration of the intes-
tinal tract or bladder, or (iii) infection of a hæmatoma from
intra-abdominal bleeding.

Indications for Treatment.—(1) When aseptic surgical care
is accessible, immediate laparotomy is usually indicated, with
repair of perforation, control of bleeding, and provision for
drainage. Delay of more than a few hours renders the prog-
nosis much more grave, and in many of the late cases expectant
treatment is preferable, since extensive procedures add to the
shock and spread the infection. When localized abscesses
develop, these may be opened and drained.

(2) An elective operative wound of the abdomen, *laparotomy*,
is made to gain access to the peritoneal cavity or intra-abdom-
inal structures. There are a great number of types of incisions,
each adapted for special purposes, or selected at the discretion
of the surgeon. All involve: (a) Incision through the skin and
subcutaneous fat. (b) Division of the deep fascia, sheath of
the rectus muscle, or aponeurosis of the external oblique. (c)
All incisions except those through the linea alba require dis-
placement or separation of muscle fibres, and some include a
transverse division of muscles. (d) Incision of the parietal
peritoneum, in addition to the special intra-abdominal pro-
cedures in a given case. To secure firm union and a solid ab-
dominal wall, there must be: (1) Absolute asepsis and clean
wound healing. (2) Accurate apposition by suture of each
layer: (i) Peritoneum, (ii) muscle, (iii) deep fascia, (iv)
subcutaneous fat, and (v) skin.

This accurate union of the divided layers may be prevented
by: (a) Infection or breaking down of the wound. (b) Drain-
age through the wound when this is indicated for septic condi-
tions within the peritoneum. In favorable cases, when drainage
is maintained for only a few days, most of the wound is protected

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and heals properly with a firm scar. In unfavorable cases, certain layers fail to unite completely as a result of sepsis or incomplete union and subsequent tension. The result is a weakening of the scar and the development of a "post-operative hernia."

C. **Hernia** or **"rupture"** is a protrusion of abdominal contents through the walls of a cavity (abdomen), forming a prominent swelling under the skin and subcutaneous tissue. Types: (1) Post-operative hernia through a weakened or incompletely healed abdominal wound. (2) Hernia through one of the normal potential openings of the abdomen: (a) umbilicus, (b) inguinal canal, (c) femoral canal.

In all types of hernia, we have to consider: (1) The *ring* or neck which is formed by the opening of the canal or the muscle and layers of fascia surrounding the rupture in a post-operative hernia. (2) The *coverings* of the hernia include the skin, subcutaneous tissue, and one or more layers of fascia. (3) The *sac*, composed of peritoneum and continuous with peritoneal lining of the abdomen. (4) The *contents*, which may be: Peritoneal fluid, omentum, intestine, bladder, or rarely, the tube or ovary.

EVIDENCE OF HERNIA.—A swelling or tumor about the umbilicus, an operative wound, in the groin, labia majora, or scrotum. This may be present only after exertion, or be constant. It is increased by straining, and transmits a characteristic impulse on coughing. The contents can usually be reduced by careful manipulation, and a definite opening can be demonstrated on examination. The patient complains of the swelling, a sense of drawing or weakness in the region, and there may be more or less gastro-intestinal disturbance from peritoneal irritation in some cases. The course of development is usually a progressive increase in the extent of the swelling and size of the opening. The peritoneal sac forms in the initial stage of the process and its presence in the hernia prevents any tendency to spontaneous closing of the canal or neck. Any increase of intra-abdominal pressure (straining, coughing, or exertion) tends to further distend the sac and increase the size of the hernia. *Reducible hernias* are those whose contents can be reduced, *i.e.*, by means of gentle manipulation, forced through the opening into the abdominal cavity.

COMPLICATIONS of hernia are: (1) *Incarceration* of the con-

tents, caused by adhesions to the walls of the sac, or constriction of the neck or ring so that the hernia can no longer be reduced by manipulation.   This condition is a contra-indication to the use of a " Truss," since there is danger of irritation of the contents, and the hernial opening can no longer be kept closed.

(2) *Strangulation* of hernial contents, *i.e.*, interference with the blood supply of structures in the hernial sac, may be due to constriction of the neck of the rupture, or to torsion and constriction of the protruding parts.   Gangrene of the structure and peritonitis follow within a short time, forty-eight hours to a few days.

(3) *Intestinal obstruction* is usually associated with strangulation of a portion of the intestine in a hernial sac, either as a cause or an effect.   This condition presents a serious emergency (see page 189) and is fatal unless relieved within a few hours.

Principles of Treatment.—(1) *Palliative.*   Umbilical and inguinal hernia in infants can be retained and often cured by a suitable support.   In older individuals simple hernias, inguinal or femoral, can usually be retained by means of a "truss." Symptoms are relieved and further increase is prevented, but cure is not to be expected.   The presence of an incarcerated hernia contraindicates the use of a truss, since it is no longer possible to retain the abdominal contents and there is danger of injury from the truss.

(2) *Operative* treatment is indicated as an emergency procedure in strangulation or intestinal obstruction. Incarcerated hernia is a positive indication for operative measures: (*a*) Since this presents the only hope of a cure; (*b*) no truss or support can retain the contents and there is a progressive increase in size, and (*c*) there is a constant danger of strangulation or intestinal obstruction.   Simple hernias in older children or adults can be cured only by operation.   This is indicated: to relieve symptoms and incapacity for work, to prevent increase in size, and to remove the danger of serious complication.   It is commonly advised for all individuals unless there is a definite contraindication to a comparatively simple operation, which is often done under local anæsthesia.   The following steps are involved: (i) Incision and exposure of the peritoneal layer.   (ii) Dissection of the sac to the level

of the peritoneum. (iii) Opening the sac and reduction or excision of the contents, as may be indicated. (iv) Ligation of the neck, excision of the sac, and closure of the peritoneum. (v) Overlapping and accurate closure of the muscles and fascia forming the hernial opening.

Special characteristics of various forms of hernia:

(1) POST-OPERATIVE hernia occurs at the site of a former abdominal wound where union of the various layers is incomplete, or subsequent separation has taken place. The swelling is diffuse and the neck is rather large. Incarceration is common, but strangulation rarely occurs. The contents include: (a) Omentum, which is often adherent and has to be excised; (b) intestine, which is also often adherent and likely to be injured at operation. Suitable supports give comfort and may relieve symptoms, though the patient is incapacitated for active work, and the condition tends to increase. Surgical repair offers the only hope of cure and is commonly advised as early as possible unless there is some definite contraindication. The procedure presents greater risks than does the operation for other types of hernia, and recurrence is also more frequent.

(2) Hernia through normal openings or canals: (a) The *Umbilicus.* During embryonic life there is a definite opening in the abdominal wall through which the umbilical vessels pass, and at one stage of development there is a diverticulum from the intestinal tract (Meckel's diverticulum) extending into the umbilical cord. The opening normally closes at birth, leaving a firm resistant wall. Umbilical hernia occurs most often in the new-born or during early infancy as a result of incomplete closure of the opening. Treatment consists of reduction of the hernia and tight strapping across the umbilicus with adhesive plaster. Cure usually results within a few weeks if the hernia can be reduced and retained. Serious complications are rare. In exceptional instances a large hernia occurs, to a degree that a considerable portion of the abdominal organs are contained in the umbilical hernial sac. For these extreme cases operation is necessary, though occasionally is unsuccessful.

Umbilical hernia, or some form of "ventral hernia," occurs occasionally in the adult, caused by: (i) Defect in the sheath of the rectus muscle especially about the umbilicus. (ii) Separation of the rectus muscles. These herniæ may reach tremen-

dous size and present the same complications and considerations for treatment as does post-operative hernia.

(b) *Inguinal hernia* occurs through the inguinal canal, most often in the male and only rarely in the female. The inguinal canal is an oblique space through the abdominal wall containing the vessels and ducts of the testes in the male (and the round ligament of the uterus in the female), and passing from the abdominal cavity to the testes (or the labium majora). The canal is a more definite space in the male, which fact explains the greater frequency of inguinal hernia in boys and men. The condition may occur: In *babies* as a result of congenital defect, when it is usually reducible and often cured by a proper truss, though some cases recur later. In the *adult* the causes are: (i) Recurrence or persistence of congenital hernia. (ii) Weak muscles and undue strain, especially if continued or repeated. Complications are: Incarceration, strangulation, and intestinal obstruction, which demand suitable surgical relief. In simple cases operation is elective but offers the only means of cure.

(c) *Femoral hernia* occurs through the "femoral ring" or canal, a passage under Poupart's ligament (see Anatomy) to the inner side of the femoral vessels. The canal is normally filled with fat and lymph-nodes, but a hernia occasionally descends through it to the inner side of the thigh, not into the scrotum or labium majora, as is the case with inguinal hernia. This type occurs more often in the female. Incarceration and strangulation are frequent complications. Suitable trusses may protect the opening and prevent the descent of abdominal contents but have no curative effect on the hernial opening. Operative treatment is urgently indicated in complicated cases and is the procedure of choice in all, since it is the only means of cure.

THE PERITONEAL CAVITY

This comprises the entire abdominal cavity which is lined with the serous "parietal peritoneum" similar in structure to the pleura and pericardium. The various abdominal organs— gastro-intestinal tract, liver, spleen, kidneys, bladder, and female genital organs—develop from the posterior abdominal wall and project to a greater or less extent into the cavity. They are thus covered to a corresponding degree by a "visceral layer" of the peritoneum. The peritoneal cavity is a closed

space, except that in the female the fallopian tubes open directly into the cavity, thus giving an indirect communication through the tubes, uterus, and vagina to the exterior. It will be seen later that this communication serves as an important portal of entry for infection and pelvic peritonitis.

The MESENTERIES (Fig. 37) represent folds of the peritoneum formed by the growth of certain organs: gastro-intestinal tract and uterus, which come to lie freely in the cavity, being attached to the posterior wall by the reflection of peritoneum
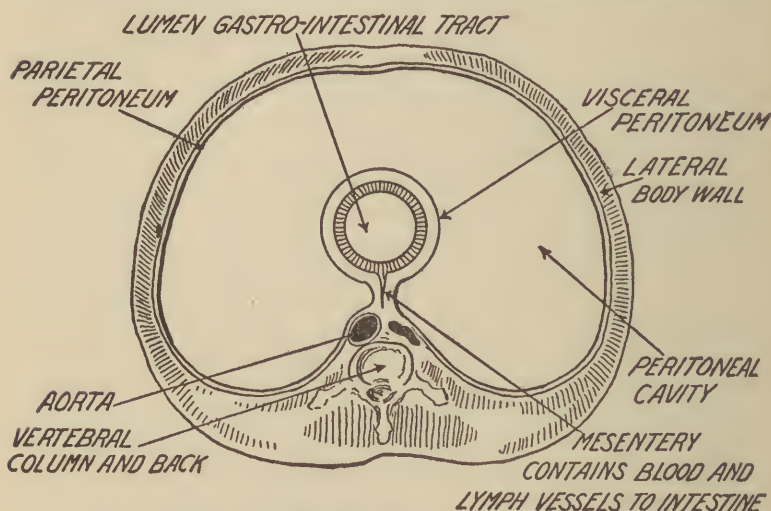
FIG. 37.—Relations of gastro-intestinal tract to the peritoneal cavity.

or mesentery. Between the layers of the mesentery, the blood and lymph-vessels and nerve supply pass from the posterior wall. The *Great Omentum* represents a fold of the mesentery of the stomach which develops and extends downward in front of the small intestines just inside of the abdominal wall. The omentum contains considerable deposits of fat, has a rich vascular supply, and normally hangs freely in the abdominal cavity. In case of local inflammatory changes in the peritoneum, the omentum becomes adherent and plays an important part in the "walling-off" process.

The peritoneal cavity normally contains a considerable

amount of clear serous fluid which prevents friction and allows free movement of the surfaces.

ASCITES refers to an increase in the amount of peritoneal fluid and occurs as a result of: (a) Mechanical disturbances in the portal circulation, as cirrhosis of the liver. (b) Lesions of the general circulation, broken compensation, due to heart or kidney disease. (c) Irritation or inflammation of the perito-neum, when the fluid soon becomes purulent. (See Peritonitis, page 168). (d) Certain malignant tumors extending into the peritoneum. Ascites is an important clinical condition, often independent of inflammation. It develops gradually, often with marked enlargement of the abdomen, and the amount of fluid may reach several quarts or gallons. The effects are mechanical pain, gastro-intestinal disturbance, interference with move-ments of the diaphragm, and consequent respiratory embar-rassment. The characteristic physical sign of "movable dull-ness" on percussion can usually be demonstrated.

Principles of Treatment.—(a) Measures to influence the underlying cause: heart, kidney, or liver. (b) Withdrawal of the fluid by aseptic puncture with a trocar. This gives marked relief, but reaccumulation frequently occurs with surprising rapidity, especially in cases due to cirrhosis of the liver. The procedure is often repeated at frequent intervals with no harm-ful effect. There is danger of shock and serious reaction when a large amount of fluid is rapidly withdrawn. Also injury to viscera, and peritonitis. (c) Operative measures which aim to provide permanent drainage for the accumulating fluid may be recommended in rare instances.

Peritonitis.—Inflammation involving the peritoneum may be: (1) Acute, either local, or general and diffuse. (2) Chronic, usually tubercular and more or less diffuse.

(1) ACUTE PERITONITIS.—Bacteria may reach the peritoneum and cause infection: (a) Through penetrating wounds from the exterior, either accidental or operative. (b) Contamination from gastro-intestinal tract, which is always infected, occurs: (i) By accidental wounds which penetrate the wall of the stom-ach or intestine. (ii) Operative procedures by which contents of the tract reach the peritoneum. (iii) Perforation or rupture of ulcerations of the tract: Gastric or duodenal ulcer, typhoid ulcer of the small intestine, gangrenous appendicitis, ulceration

or diverticulitis of the colon. (c) Acute cholecystitis may gradually extend to the surrounding peritoneum, or sudden rupture of a distended gangrenous gall-bladder occasionally gives rise to a diffuse peritonitis. (d) Abscess or suppuration of the pancreas is a rare cause of an extremely severe type of general peritonitis. (e) The genital tract in the female, including the uterus and fallopian tubes, when involved in acute inflammatory processes (gonorrheal or puerperal), are likely to be complicated by pelvic or general peritonitis. This may occur either by direct extension along the tubes or through the walls of the structures and surrounding tissues. (f) Perforation or injury to the urinary bladder is a less frequent cause of general peritonitis. (g) Rare causes are: rupture of the spleen, suppurating lymph-nodes, or retro-peritoneal abscess.

Course and Effects.—*General or diffuse* peritonitis results at the outset: (a) When a large amount of septic material suddenly reaches the free peritoneal cavity. Example: Rupture of a gastric ulcer or gangrenous appendix, gall-bladder, or certain penetrating wounds. (b) Sudden extension from a localized process due to rupture or surgical interference. The onset is sudden, in some cases with little definite warning. There are severe abdominal pain, high fever and toxæmia, rapid pulse, vomiting, marked distention of the abdomen and rigidity of the abdominal muscles. Later there is paralysis of the intestinal tract, more distention, and intestinal obstruction. The condition is usually fatal unless efficient treatment can be given within a few hours.

Localized or circumscribed peritonitis results when the contamination occurs more gradually about a wound, or as an extension from ulcer of the stomach, appendix or other region. It is often caused by organisms of relatively low virulence and the process extends in such a manner that protective adhesions form, between neighboring layers of peritoneum and omentum, which tend to wall off and limit the process. The favorable course in such a case consists of the development of a dense mass of adhesions and limitation of the infection to a circumscribed area (peri-appendix abscess, or pelvic peritonitis) and destruction of the organisms so that the contents may become sterile. There is constant *danger* that such protective adhesions will not limit the infection, or that they

may be broken down by active peristalsis (from catharsis) or manipulation at operation, and a rapidly progressive peritonitis result.

Evidences of local peritonitis are much the same as those of an early diffuse process: Abdominal pain, more localized, also tenderness and muscular rigidity, digestive disturbances, nausea and vomiting, abdominal distention, and constitutional evidences of infection and toxæmia. There is often history of preceding gastro-intestinal disturbance, depending on the cause in any given case. The greatest *danger* is that the process be mistaken for a simple gastro-intestinal upset from indigestion and treated by catharsis, thereby stimulating active peristalsis and interfering with nature's attempts to localize the process.

Principles of Treatment.—The most prominent symptoms, severe abdominal pain, distention, and vomiting, are caused by peritoneal irritation, and are often mistakenly considered as due to acute indigestion or constipation. If the condition is not masked by morphine, recognition of a serious surgical lesion is soon possible; therefore hypnotics are to be used with the greatest care, and then only on the direct order of the surgeon in charge. Pain is an important indication of the severity of the condition. It is a cry for help, and in most cases morphine or hypnotics muffle the cry but do not supply the help. Cathartics and fluids by mouth stimulate intestinal peristalsis, thereby increasing the pain and interfering with the walling-off process by protective adhesions. The indication is to withhold cathartics, food, and fluids by mouth till the surgeon can exclude the presence of a serious surgical lesion, not only peritonitis but inflammatory conditions which are likely to extend to the peritoneum, or intestinal obstruction. (See page 180.) Vomiting is controlled by gastric lavage in certain cases. Abdominal pain is relieved by an ice-bag and, possibly, carefully directed doses of morphine. Fluids are supplied by proctoclysis, repeated at regular intervals, also by hypodermoclysis. When indicated, the bowels may be moved by enema, and catharsis by mouth is dispensed with till the condition is clear. For the sepsis and toxæmia, suitable constitutional measures are used. Such palliative means are indicated: (*a*) In early cases till a diagnosis is made and decision reached regarding operative treatment. (*b*) As an elective procedure in certain patients

seen late after localization is taking place. (*c*) Post-operative. In some such cases operative manipulation tends to spread the process, and is best delayed till localization is complete and the resulting abscess is later opened and drained. As a rule, prompt surgical treatment presents the only means of controlling the condition, and unless this is successfully accomplished within the first few hours, the prognosis becomes rapidly worse or hopeless, especially in cases of general, diffuse peritonitis.

Surgical treatment has *two aims:* (*a*) To provide adequate drainage of the infected cavity. This may include simply a local area, *i.e.*, a walled-off peri-appendiceal abscess, or general diffuse processes including the entire cavity. In such cases it is necessary that all pockets or localizations be reached and drained. This is usually accomplished by rubber tubes which reach the bottom of special abscess cavities, and also certain regions where localization is more common, *i.e.*, the pelvis or renal fossa. The drainage tubes are brought to the surface in the laparotomy wound, through special stab-wounds at dependent regions, or through the vagina, and are left in place till the discharge has ceased and the condition is under control.

Special after-treatment is necessary: postures (example, "Fowler's position," *i.e.*, imitating the sitting posture, which secures localization of purulent material in the pelvis where drainage is better and there is less absorption of toxines). Constitutional measures to overcome infection and secure the elimination of toxines are of great value and importance. Operations to remove the causal lesions are possible in suitable cases but are often delayed until the acute stage has passed and the patient is in condition to stand extensive procedures. Example: Removal of gangrenous appendix, inaccessible to the wound. Closure of a ruptured gastric ulcer is usually accomplished at the original operation.

(2) Chronic or tubercular peritonitis occurs at any age and is usually secondary to other tubercular lesions, though these may be inactive. It is part of a constitutional disease and the local process is insidious in its onset. The infection reaches the peritoneum through lesions of the appendix, fallopian tube, or intestinal tract. *Changes* consist of: (*a*) Ascites; (*b*) characteristic tubercles on the visceral and parietal layers of the peritoneum; (*c*) localized abscesses walled off by dense

adhesions, and (*d*) in later stages of the disease there may be large masses of inflammatory tissue causing stricture or deformity of the intestinal tract. *Evidences* of the processes are: (*a*) *Constitutional* symptoms and signs of the disease: irregular temperature, night-sweats, loss of weight, and malaise. (*b*) *Local:* Increase in size of the abdomen, pain, evidence of movable dulness, free peritoneal fluid, digestive disturbance, masses in the abdomen.

Principles of Treatment.—(*a*) Constitutional and specific therapy as for other forms of tuberculosis.

(*b*) Local surgical measures aim to: (i) Eradicate the portal of entry or local lesion (appendix or fallopian tube). (ii) To evacuate suppurating areas, excess fluid, or remove masses which interfere with the function of the intestinal tract. Drainage is rarely used in these cases on account of the danger of persistent fistulæ breaking through into the intestinal tract.

The prognosis in fairly early cases is good, but constitutional treatment must be continued for months or years, as in other forms of tuberculosis. Recurrence is frequent and a case can be considered as cured only after a period of about three years of good health.

DEMONSTRATIONS

1. Demonstration of the abdominal cavity and walls, also divisions on anatomical chart.
2. Demonstration of posture and form of the abdomen in cases of marked ptosis, styles of binders and supports and exercises.
3. Cases showing types of hernia, histories of cases with complications and operative results.
4. Application of "skein truss" in children, and strapping for umbilical hernia in infants, application of truss in adults.
5. Demonstration of the various canals on anatomical chart.
6. Styles of "trusses" and application.
7. Demonstration of: the mesentery, omentum, and serous layers on anatomical chart or laboratory animal.
8. Case histories of general peritonitis following various abdominal lesions.
9. Apparatus and method of abdominal paracentesis.
10. Demonstration and methods of post-operative treatment of general peritonitis.
11. Case histories of tubercular peritonitis.

CHAPTER XII

THE GASTRO-INTESTINAL ORGANS

THESE include: The gastro-intestinal tract proper: stomach, small intestine, large intestine, colon, rectum, anus, and appendix; the accessory organs: liver, bile passages, pancreas, and spleen.

GASTRO-INTESTINAL DISTURBANCES

(1) ACUTE INDIGESTION, characterized by abdominal pain, local tenderness, nausea, vomiting, abdominal distention and distress, results from a variety of conditions, and may be an important indication of serious surgical lesions. *Causes:* (a) Irritating substances in the tract. (i) Poisons: Arsenic, mercury, or "ptomaines" which set up a sharp reaction with pain, vomiting, and diarrhœa, representing an attempt to empty the tract, but is not associated with fever. (ii) Acute indigestion from improper foods, drinks, or constipation may cause pain, nausea, vomiting, or diarrhœa, but no fever, or marked local tenderness. (b) Obstruction of the bowels causes severe general abdominal pain and distention, persistent vomiting which finally becomes fecal, and marked prostration. (c) Inflammatory lesions of the appendix or gall-bladder are associated with localized pain, tenderness, muscle rigidity protecting underlying structures, with fever and sepsis, as well as digestive disturbances. (d) Peritonitis from any cause.

The *important considerations* in this connection are:

(a) That the most prominent symptoms, pain, nausea, and vomiting, may be caused either by simple irritations which clear up when the causes are removed by vomiting or catharsis; or by serious inflammatory lesions for which surgical measures are urgently indicated.

(b) The severity and persistence of the symptoms serve to indicate the nature of the cause, and should not be masked by morphine or hypnotics.

(c) In any case food or fluids by mouth increase the irritation and peristalsis, therefore should be withheld till the condition is controlled.

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(*d*) Cathartics stimulate peristalsis, often increase the pain and vomiting, and are a positive danger in case of organic or inflammatory lesions. Therefore they are best withheld till the nature of the condition has been determined.

(*e*) Serious complications, or a fatal outcome, are often caused by mistaking the early stage of an inflammatory lesion (appendicitis) for a simple indigestion, and giving improper treatment (cathartics), or masking the symptoms and signs by morphine. Persistent vomiting, definite localized pain, tenderness, or muscle rigidity, fever, leucocytosis, or evidence of sepsis, indicate a serious lesion of the intestinal tract, and threatened peritonitis.

(2) CHRONIC INDIGESTION includes: Persistent or recurrent gastro-intestinal disturbance, pain in relation to food, attacks of nausea and vomiting, constipation or diarrhœa.

Causes.—(*a*) Constitutional diseases, nephritis, diabetes, anemia, "Grave's disease," cardiac lesions. (*b*) Chronic intoxications: lead, alcohol, or tobacco. (*c*) Nervous conditions: improper diet, lack of exercise, constipation. (*d*) Organic disease, surgical lesions: gastric or duodenal ulcer, cholecystitis, chronic appendicitis, tuberculous peritonitis, malignant disease, or lesions of the female genital tract.

Considerations.—(*a*) Chronic indigestion or recurrent attacks of pain, nausea and vomiting may indicate either a constitutional "medical condition" or a serious surgical disease.

(*b*) The first three groups of causes can usually be discovered or eliminated by the history, examination, or careful observation.

(*c*) Organic surgical lesions of the various structures may be more or less evident from the history or examination, and will be considered under special sections.

(*d*) Many cases of chronic or recurring indigestion are caused by definite surgical lesions, the nature of which can be discovered only at exploratory operation.

(*c*) In instances of definite disturbance where constitutional or nervous disease and the element of chronic intoxication can be eliminated, the question of an obscure surgical lesion (gastric ulcer, cholecystitis, chronic appendicitis) and especially malignant disease must be seriously considered. Exploratory operation is often advised in order to make a diagnosis and

prevent the development of serious complications, or inoperable cancer by early radical removal.

The **Stomach** (Fig. 38) is located in the upper abdomen in the epigastric and left hypochondriac regions. (See Anatomy and Physiology for the relations and structure.) Surgical lesions of the stomach include: (1) Malformations, congenital and acquired; (2) wounds and foreign bodies; (3) ulcer, and (4) malignant disease.
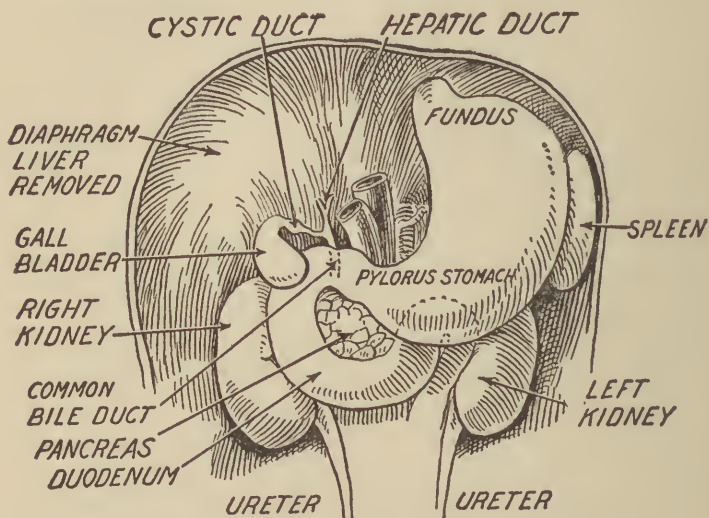
FIG. 38.—Relations of stomach, duodenum, pancreas, and spleen.

1. *Malformations.*—(*a*) Congenital *stenosis* of the pyloric region, with or without hypertrophy, is an important condition, seen usually in new-born infants. It is characterized by partial or complete constriction of the pylorus, often to a degree preventing passage of contents of the stomach into the intestine. There is constant or recurrent vomiting, and regurgitation of stomach contents, marked loss of weight, malnutrition, distention of the upper abdomen, and abnormal stools. Certain of the cases are due to spasm of the circular muscle of the pylorus, and are relieved by suitable medical and dietetic treatment. Others are caused by actual malformation with stricture or occlusion of the lumen, and the effects persist in spite of most

careful treatment. The condition is recognized by: (i) the use of the stomach-tube, (ii) examination of the stools, and (iii) the rapidly developing malnutrition from starvation. It is most important that the nature of the condition be promptly recognized in order that proper treatment be instituted before the effects of starvation are too great.

Surgical treatment is indicated where there is complete obstruction, since if this is not relieved the child will die of starvation. The operation will consist of either a gastro-enterostomy, a plastic operation on the pylorus, or a simple enterostomy for temporary feeding.

(b) *Acquired malformations* consist of strictures which are secondary to ulcers or cancer, and cause obstruction to the normal passage of stomach contents. The "hour-glass" stomach is caused by the constriction of scar tissue from an ulcer of the "lesser curvature," resulting in a constriction through the middle of the organ, which is thus incompletely divided into two pouches. The condition is recognized by Röntgen ray examination after feeding with bismuth mixtures. Treatment may be indicated where drainage of one of the pouches is incomplete and there is retention of contents. Surgical operation may consist of plastic reconstruction of the stomach or an anastomosis between the two sacs. *Stricture* at the *pylorus*, due to ulcer or cancer, is more common, and is often preceded by a more or less suggestive history of gastric ulcer or chronic indigestion. The result is an enlarged, dilated stomach, with retention of contents. Evidences are: regurgitation or vomiting of food which has been taken several hours previously. Gastric lavage demonstrates a retention of stomach contents. This can be confirmed by studies with bismuth feeding and X-ray examinations. Positive findings indicate pyloric obstruction sufficient to demand treatment to secure proper drainage, regardless of the cause.

Principles of Treatment.—(i) Excision of the area of constriction with reconstruction of the tract (anastomosis between the stomach and small intestine). (ii) Anastomoses between the duodenum and stomach, "pyloroplasty." (iii) Simple gastro-enterostomy which prevents retention of contents in the stomach, and relieves irritation from the passage of stomach contents at the area of constriction or ulceration.

(c) *Acute dilatation* of the stomach (see page 174) consists of a spastic closing of the pylorus and often of the cardiac opening resulting in retention of contents, atony of the stomach wall, and extreme dilatation of that organ. The stomach is unable to expel its contents, may reach tremendous size and embarrass respiration or cardiac action by mechanical pressure.   Treatment: Gastric lavage done as early as the condition is suspected and repeated at frequent intervals, since the dilatation often recurs.

2. WOUNDS penetrating the wall of the stomach result in a rapidly spreading, diffuse peritonitis, and call for prompt surgical relief.   (See page 169.)   Foreign bodies which are swallowed are likely to be retained in the stomach and are usually recognized by X-ray plates or fluoroscopic examination. Dangers are: Irritation of the stomach, penetration of the wall, or ulceration through, and peritonitis.   Prompt removal by surgical operation is indicated.

3.   ULCERS of the stomach and duodenum, while distinct anatomically, present similar clinical findings and symptoms. Causes are indefinitely understood, though there are many underlying factors:

(a) Infection in other parts of the body.   The streptococcus is closely associated as a cause and may be derived from a previous tonsillitis or appendicitis.

(b) Diet and habits of eating have an indirect influence in causing ulcer, and certain dietary restrictions are necessary in the treatment.

(c) Hyperacidity, *i.e.*, increase in the hydrochloric acid, is present in most cases of ulcer.   This is sometimes claimed to be a cause of the condition, and certainly increases the symptoms and pain.   It is well known that alkalis (sodium bicarb.) relieve the pain and discomfort and have a favorable influence on the course of the disease.

Course and Symptoms.—The course is somewhat chronic. The condition begins as an erosion in the mucous membrane and extends as an open ulcer on the surface.   Complete healing with no deformity or scar is possible, but in many cases excessive scar tissue persists, with contraction or stricture, especially in ulcers of the pylorus or duodenum.   Extension through the wall of the stomach with localized peritonitis, or sudden rupture

of the weakened ulcer base and acute general peritonitis are occasional results. The term *chronic ulcer* refers to certain ones which persist due to repeated or continued irritation, with resulting deformity or lesions causing persistent digestive disturbances.

Symptoms.—(*a*) Pain in the region of the stomach is a prominent symptom in most cases. This is characterized by the fact that it appears from two to four hours after eating when the stomach is empty, being a "hunger-pain." It is relieved by taking food or by the use of large doses of sodium bicarbonate, either of which acts by neutralizing the free hydrochloric acid which irritates the ulcer and causes pain.

(*b*) Local tenderness is generally evident.

(*c*) "Hæmatemesis," vomiting of blood, is usually present at some time and may present the first definite indication of the nature of the lesion. The *vomiting* of a considerable amount of fresh free blood is important evidence of gastric ulcer, and always presents urgent indication for intensive treatment.

(*d*) "Occult blood" in the stools may be demonstrated by suitable tests in a large percentage of cases, especially ulcers of the duodenum.

(*e*) Acid regurgitations are frequently present, but vomiting is not a characteristic symptom unless there is obstruction of the pylorus and food-retention. Secondary symptoms include: anemia from hemorrhage, loss of weight and malnutrition from continued digestive disturbance, and complications.

Complications.—(*a*) *Hemorrhage*, when of considerable amounts, or repeated, may threaten life and be fatal, or result in a high-grade anemia. At times it is the first indication of serious gastric disease, but may occur at any stage. Special indications for treatment are: Absolute rest in bed and immobilization of the gastro-intestinal tract by adequate doses of morphine, withholding of foods and fluids by mouth, and the ice-bag locally. Enemas and rectal feeding are used later, till the hemorrhage is controlled, when a careful return is made to fluids by mouth, and suitable treatment of the ulcer is instituted. In some cases the surgeon will wash the stomach, using an alkali, sodium bicarbonate or adrenalin. The evacuation of clots relieves irritation and lessens the tendency to recurrence of bleeding. In a few selected instances, surgical operation may be

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advised to control the bleeding, though there is great difference of opinion on this point.

(b) *Perforation* and rupture of a gastric ulcer often occurs with no warning and only indefinite evidence of previous disturbance. The most typical and dramatic attack follows rupture of an ulcer on the anterior wall of the stomach, resulting in sudden diffuse peritonitis. There is sharp, severe abdominal pain and prostration, rapid pulse, rising temperature, rigid, distended abdomen, making the picture striking. Prompt surgical treatment is most urgently indicated within the first few hours. The prognosis grows rapidly more hopeless as this is delayed. Objects to be accomplished by operation are: Closure of the perforation and drainage of the peritoneum, and if possible, surgical treatment of the ulcer, excision or gastro-enterostomy. Perforation of an ulcer on the posterior wall of the stomach results in a localized peritonitis and abscess formation, more gradual in development and with less urgent indications for surgical relief.

(c) Development of a *chronic ulcer*, with persistent or recurrent symptoms, and deformity from contracting scar tissue. This is an occasional sequel of the acute type of ulcer and indicates that healing and cure is incomplete. Definite persistent food retention is evidence of constriction at the pylorus and is one indication for operative treatment.

(d) The relation to *malignant disease*, cancer. There is suggestive evidence that a healing chronic ulceration may give rise to the development of malignant disease in a considerable number of cases, and this fact is an indication for radical surgical excision of chronic ulcers of the stomach. On the other hand, cancer of the stomach, in the early stages, may be mistaken clinically for chronic ulcer and undergo serious extension while the case is being treated conservatively. These facts, therefore, present definite indication for exploratory operation, in doubtful or persistent cases.

Principles of Treatment.—(a) *Medical treatment*, to be adequate, must be systematic and persistent, including several weeks of careful diet, with suitable medication. Nothing less than such a course under the care of a conscientious medical man, preferably in a hospital, should be considered for any case where a diagnosis of gastric ulcer has been made. When this is done a con-

siderable number of cases will recover completely with no complications or after-effects. However, in spite of such treatment, a certain group of cases will persist and require surgical treatment.

(b) Indications for *surgical treatment* are: (i) Rupture of an ulcer, with general peritonitis or localized abscess. (ii) Cases where thorough medical treatment is for any reason impossible. (iii) Cases which persist or grow worse in spite of medical treatment. (iv) Chronic cases with suspicion of cancer or evidences of food retention. Surgical treatment may consist of: (a) Excision of the ulcer and reëstablishment of the continuity of the gastro-intestinal tract by suitable anastomosis. This is the ideal procedure, but involves much manipulation and more danger of shock. (b) Gastro-enterostomy may be done to relieve pyloric obstruction, food retention, and prevent further irritation of the ulcer area. This operation is essentially a palliative one but results in a large number of cures.

4. CANCER of the stomach occurs most commonly in the pyloric region of the stomach, and in individuals over forty years, though sometimes found at an earlier age. The causes are discussed under the question of cancer (see page 46). Of particular clinical interest is the relationship to chronic ulcer as mentioned under that subject. The early symptoms are not specific, and are those of chronic or recurring indigestion, with evidences of food retention in the stomach. The important consideration is, that the occurrence of such attacks in an individual who has been previously well, and with no constitutional causes, is strong presumptive evidence of organic surgical lesion, possibly cancer. It happens not infrequently that such cases which appear clinically to be due to constitutional or dietetic causes, or possibly to chronic ulcer, develop while under observation, and are recognized as cancer only when they have become inoperable. It is most urgent that such doubtful cases where cancer cannot be reasonably excluded, be given the benefit of exploratory laparotomy early in the course, if there is to be hope of successful cure.

The characteristic evidences of gastric cancer: Palpable tumor, typical findings in the stomach contents, loss of weight, mal-nutrition, and cachexia, indicate advanced disease which too often is inoperable. The presence of metastatic growths in

other parts of the body, particularly the liver, indicate an inoperable condition with a hopeless prognosis.

Operative treatment may be: (a) Radical removal of a portion of the stomach and gastro-enterostomy, which is the ideal procedure, is indicated in early localized growths. (b) Palliative gastro-enterostomy is done in late cases with food retention causing persistent vomiting, and is followed by marked temporary improvement.

THE INTESTINAL TRACT

This includes the small intestine, vermiform appendix, large intestine or colon, and the rectum and anus. It is conveniently considered under separate heads: Lesions of the entire tract, obstruction. Lesions of the small intestine. Lesions of the colon. Lesions of the rectum and anus. Lesions of the vermiform appendix.

Lesions of the entire tract. " Ileus " intestinal obstruction: (A) sudden, complete obstruction. (B) Incomplete or gradual obstruction, usually secondary to other lesions of the tract.

A. SUDDEN COMPLETE OBSTRUCTION of the intestinal tract may be caused by: (1) *Strangulated hernia*. (a) External, inguinal or femoral hernia (this type has already been considered under hernia; see page 163), or (b) internal hernias into bands of adhesions secondary to inflammatory processes, or folds of omentum.

2. *Volvulus*, the rotation of a loop of intestine, usually sigmoid, upon its mesentery, occluding the lumen of the bowel, and cutting off the blood supply. (See Fig. 39.)

3. *Intussusception*, or invagination of a portion of the intestine into the part distal to it. This may be due to malformation of the intestine or mesentery associated with irregular peristalsis, and is found most often at or near the ileo-cæcal junction. It occurs most frequently in children. (See Fig. 40.)

4. *Occlusion* of the lumen by foreign bodies. Example, gall-stones which have ulcerated into the intestinal tract, or fecal concretions.

5. *Ileus paralyticus*, paralysis of the intestinal walls without mechanical obstruction, may be secondary to peritonitis and distention, or to more remote causes, reflex disturbance of the sympathetic nerve supply.

6. *Stricture* of the intestine from ulcerations due to tuberculosis or malignant disease, in which cases there is usually history of digestive disturbances or previously partial obstruction.

Effects and symptoms:

1. *Distention* of the abdomen due to accumulation of gas in the intestinal tract proximal to the obstruction.

NORMAL SIGMOID AND MESENTERY
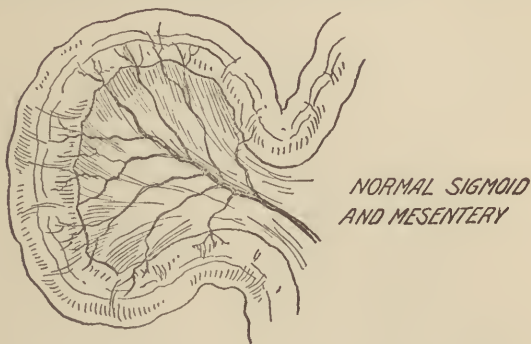
ROTATION OF LOOP ABOUT ITS MESENTERY CAUSING OBSTRUCTION
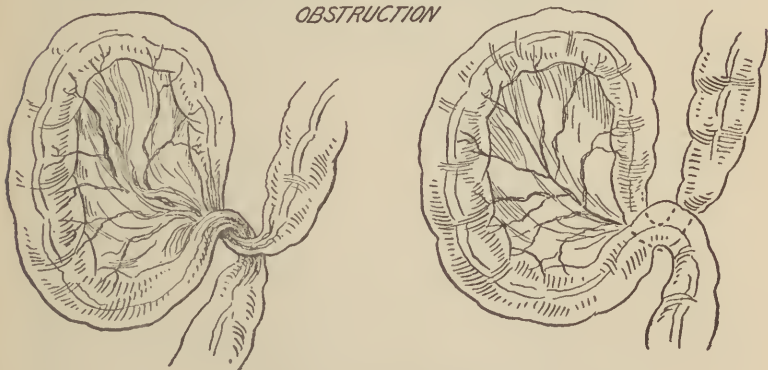
Fig. 39.—Volvulus of sigmoid.

2. *Vomiting*, which is more or less constant, and is increased by taking fluids or cathartics by mouth. Later there is regurgitation of intestinal contents and the vomiting becomes fecal in character.

3. *Pain* due to the distention, vomiting, and active peri-

stalsis, which is increased by foods, fluids, or cathartics taken by mouth.

4. *Constipation*, usually absolute, with no passage of flatus or fæces. Cathartics by mouth increase the pain and vomiting by causing ineffective intestinal peristalsis. They are contra-indicated in cases suggesting obstruction. Enemas are usually unproductive but do no positive harm, and should be tried in all suspicious cases.
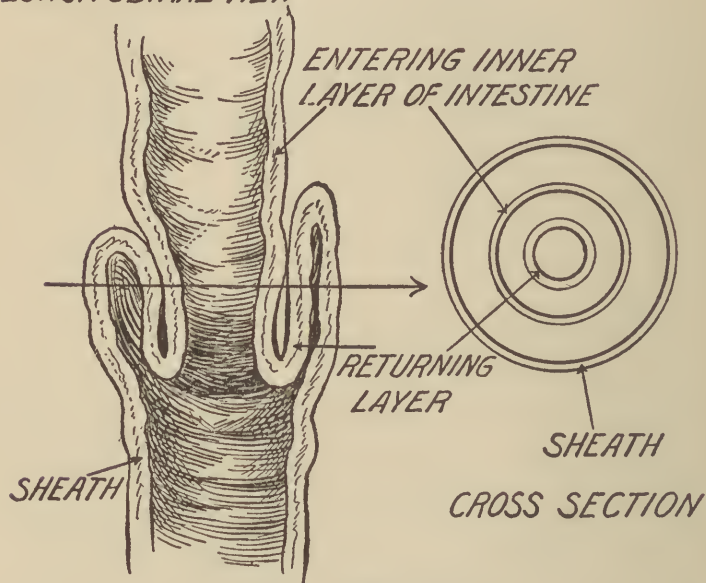
Fig. 40.—Intussusception.

In certain instances of volvulus, high enemas may overcome the obstruction. In case of a lesion high in the tract, or of in-tussusception, there may be one or more scanty movements, often containing blood or mucus.

5. *Shock and prostration* is usually present early in the course, due to the pain and distress. Later there is toxæmia and sepsis caused by absorption of toxines from the tract, or gangrene of strangulated portions of the intestine, eventually causing death in spite of treatment. The *onset* is sudden, with

severe pain, persistent vomiting which becomes fecal in charac-
ter, distention of the abdomen, and lack of bowel movement.
Within a few hours there is marked prostration, followed by
toxæmia and sepsis.   High enemas are ineffective.   Progress
is rapid and the condition is fatal unless relieved within from
thirty-six to seventy-two hours, before marked toxæmia is
present.   The *prognosis* is usually good provided the obstruction
is relieved within twenty-four hours, but grows rapidly unfa-
vorable if this is delayed.   Evidence of toxæmia or sepsis indi-
cates a grave prognosis.   The presence of a strangulated hernia,
acute inflammation in the abdomen, post-operative peritonitis,
or previous gastro-intestinal disturbance may suggest the
diagnosis.   The clinical picture is fairly typical and is usually
recognized.   Failure to make a safe early diagnosis and the use
of cathartics or morphine during the early stage are responsible
for dangerous delay, aggravation of symptoms, and many fatal
results.

   Principles of Treatment.—(1) Palliative.   Vomiting is best
controlled by withholding food and fluids by mouth, and by gastric
lavage.   Pain is relieved by the same measures, and the use of
an ice-bag.   Morphine is dangerous in that it masks the pain
which is an important indication of the severity of the condition.
It should be used only on the direct order of the physician: (*a*)
After the operation has been arranged for.   (*b*) In certain early
cases of volvulus with high enemas, thus attempting to over-
come the obstruction.

   2. Surgical treatment aims: (*a*) to relieve the obstruction,
and (*b*) to re-establish the patent lumen of the intestinal tract
by (i) operative reduction of a strangulated hernia; (ii)
correction of a volvulus; (iii) reduction of an intussusception;
(iv) drainage of peritoneum, and (v) excision of gangrenous
intestine, with suitable anastomosis.   Certain desperate, neg-
lected cases are so prostrated by toxæmia at the first operation
that nothing more is possible than an enterostomy, opening the
intestine above the obstruction to drain the tract of toxic ma-
terial, and relieve immediate symptoms.   The remainder of
the operation is delayed till the acute obstructive symptoms
are overcome and the condition of the patient is improved.
Cases of "ileus paralyticus" often present no gross anatomical
lesion which can be treated surgically, and the physician must

use other measures, high enemas of oil and glycerin, soapsuds and turpentine enema, etc., together with certain drugs to stimulate intestinal peristalsis, eserin or pituitrin hypodermically.

B. GRADUALLY DEVELOPING complete or partial obstruction may be caused by: (1) Constriction or stricture, due to scar tissue of ulcers, tuberculous or malignant. (2) Pressure of an abdominal, ovarian, or pelvic tumor. (3) Congenital or inflammatory bands or adhesions.

There is usually a history of preceding gastro-intestinal disturbances, pain, distention, constipation, or, in some cases, alternating constipation and diarrhœa. If the lesion is in the pelvis or lower colon, there may have been ribbon-like stools. In case of fresh ulceration or malignant disease of the intestine, there will be gross bleeding or occult blood in the stools. Inflammatory conditions will be associated with an elevation of temperature and evidence of sepsis.

The onset of complete obstruction may be sudden, but there is usually a suggestive history of previous gastro-intestinal disturbance. The symptoms are less urgent, the constipation is often relieved temporarily by enemas, but recurrence is common. Later there is constitutional evidence of a serious lesion, infection or tumor. Diagnosis of the nature of the case can often be made from the history, careful observation during an attack, and examination, especially with bismuth meals or enemas, and X-ray plates.

Principles of Treatment.—(1) Palliative measures often serve to relieve the acute condition, after which the case can be studied and elective operation advised as indicated. (2) Surgical measures may be necessary as in acute obstruction, except that removal of the cause is often postponed for secondary operation. (3) Definite evidence of organic obstruction is an indication for exploratory operation, since this is often the only early sign of malignant disease of the intestinal tract at a stage when successful removal is possible.

SMALL INTESTINE.—The "duodenum" (see Fig. 38), including the first twelve or fourteen inches of the small intestine continuous with the stomach, is closely attached to the posterior body wall, and lies in close relation to the gall-bladder, pancreas, and right kidney, and is continuous with the movable part of the small intestine at a fixed point behind the stomach. The re-

mainder of the small intestine is suspended in a free fold of mesentery, and is divided anatomically into the *"jejunum,"* comprising the upper portion, and the "ileum," including about the lower two-thirds. The two portions are continuous, with no definite line of demarcation, but differ somewhat in structure.

Lesions of the small intestine include: (A) Wounds, (B) ulcers, (C) cancer.

A. Wounds penetrating the intestine are most often the result of gunshot, in which case there are usually several perforations in various parts of the tract. Peritonitis is inevitable and is most often fatal unless controlled by prompt operation, repair of perforations, and drainage. In a few cases where surgical relief is not accessible for a number of hours, and the patient survives the resulting peritonitis, palliative operative measures are delayed till a localized abscess forms, which is then opened and drained.

B. Ulcers include three varieties: (1) Duodenal, (2) typhoid, (3) tuberculous.

1. *Ulcers of the duodenum* are similar in their clinical effects to those of the pyloric region, with the following exceptions: (a) The pain comes on longer after eating, from four to six hours, but is relieved by food and by alkalis. (b) Perforation, when it occurs, is into the free peritoneal cavity and the results are even more disastrous than those from ruptured gastric ulcers. (c) Hemorrhage is not so evident in the stomach contents, but is seen in the stools, or demonstrated as "occult blood" by suitable tests. (d) Malignant disease is comparatively rare in the duodenum.

2. *Typhoid ulcerations* occur in the "Peyer's patches" of the ileum, and cause two important complications: (a) Concealed hemorrhage, which is treated on general principles (see page 54); (b) perforation or rupture of an ulcer with rapidly spreading diffuse peritonitis which is fatal in the absence of prompt surgical treatment, drainage, and closure of the ulcer. Normally the typhoid ulcers heal with no deformity or after-effects in the intestinal wall.

3. *Tuberculous ulcers* may occur at any level of the intestinal tract and are transverse to the long axis of the bowel. In healing they are likely to cause constriction of the lumen of the tract. They may also extend to the peritoneum with the development

of tubercular peritonitis, or large masses of inflammatory tissue in the wall of the intestine.

C. MALIGNANT DISEASE of the small intestine is quite rare and there are no characteristic symptoms in the early stages. It is discovered accidentally at operation as a cause of intestinal obstruction or obscure disturbances.

LARGE INTESTINE, "colon." Anatomically this is divided into: the "cecum" and "ascending colon" on the right side, the "hepatic flexure" in relation to the liver, the "transverse colon" extending across the abdomen attached to the greater curvature of the stomach, the "splenic flexure" and "descending colon" on the left side, the "sigmoid flexure" with its mesentery lying freely in the pelvis, and continuous with the "rectum," which extends along the sacrum to the external opening at the "anus." The *colon* is larger in circumference than the small intestine and is characterized by the "longitudinal bands," and by the numerous folds of fat "appendices epiploicæ" which are attached to the colon and hang freely in the peritoneal cavity.

Surgical lesions include: (A) Congenital or inflammatory constrictions and malpositions. (B) Fistulæ: (1) accidental, (2) operative. (C) Inflammatory lesions, ulcers and diverticulitis. (D) Malignant disease.

A. CONGENITAL CONSTRICTION or occlusion is a rare condition present in the new-born. If the occlusion is absolute, as indicated by absence of bowel movement, surgical relief is necessary at once. This may consist of: (1) A "colostomy" above the obstruction, or (2) an anastomosis between the portions of the intestine above and below this point.

Malposition of the colon may occur: (1) As a congenital anomaly, and cause symptoms of obstruction only under certain conditions. (2) As a result of "ptoses" and relaxation of the abdominal walls. (See p. 160.) (3) From inflammatory adhesions fixing a portion of the colon in an abnormal position. Example: The transverse colon becomes adherent to a pelvic abscess. Results: There is a "stasis" of intestinal contents with constipation and secondary effects, "colitis." The condition is recognized by Röntgen-ray plates taken after bismuth meals have reached the colon, or enemas of similar mixtures have been given.

Operative measures are of value only in certain cases and include· (1) Releasing adhesion. (2) Suture of the bowel,

fixing it in normal position. (3) Anastomoses, or "short-circuiting operations," which throw the involved portion of the colon out of function. (4) Resection of the diseased colon in certain selected cases.

B. A FISTULA or abnormal opening into the colon includes two types: (1) Accidental fecal fistula complicating abscess or operation. Example: A fecal fistula into the cecum following operation for appendicitis, usually in cases where the cecum is involved in the inflammation. Spontaneous closure is the rule. In occasional cases operation is necessary, and consists of: (a) Excision of the fistulous tract; (b) suture of the intestinal opening, and (c) closing the muscle and skin wound.

(2) Therapeutic fistula, "colostomy," or artificial anus, is made to secure an opening into the intestinal tract in cases: (a) When there is an intestinal obstruction below that point, which cannot be relieved at the first operation. (b) In cases of chronic infection or ulceration of the colon, to secure rest, relieve irritation of the diseased portion, and allow treatment by irrigation. (c) In case of cancer of the colon or rectum, either for a permanent anus, or as a preliminary step to radical removal of the growth. Under favorable conditions such a fistula causes only slight inconvenience and gives satisfactory results.

C. INFLAMMATORY LESIONS.—(1) Ulcers. Tuberculous ulceration is most frequent about the cecum and may form a large mass of inflammatory tissue or occlude the lumen of the intestine. Resection of the involved portion and suitable anastomoses may be done in selected cases, followed by constitutional treatment. (2) "Colitis." Ulcers and chronic infection of the large intestine are not infrequent, and are associated with changes in the mucous membrane, thickening of the wall, and possibly constrictions from scar tissue. These conditions are insidious in their onset, being characterized by frequent, painful bowel movements, blood and mucus in the stools, malnutrition, loss of weight, and secondary anemia. Constrictions and masses occluding the lumen may give rise to intestinal obstruction.

Principles of Treatment.—Certain ulcers low in the sigmoid or rectum can be treated with local applications or irrigations. If the condition is extensive and chronic, more radical surgical measures are necessary. (a) "Colostomy" or enterostomy is

done above the level of the lesion, thus relieving the inflamed area from irritation.   In some cases irrigations are used through the colostomy wound, and the opening is maintained for several months.   This is often followed by rapid gain in weight, and general improvement, as well as cure of the local condition. (b) Resection of the diseased bowel may be indicated in certain cases, but is often too extensive an operation for the condition of the patient.

(3) *Diverticulitis* is an acute inflammation involving congenital or acquired diverticulæ of the colon, particularly of the sigmoid flexure.   It is often complicated by local abscess formation, with pain and fever, or evidence of partial obstruction.   The condition is usually obscure in onset.   Surgical treatment is necessary and may consist of: (a) Palliative colostomy for obstruction.   (b) Drainage of an abscess.   (c) Resection of the colon involved, and anastomosis, though this procedure may have to be reserved for a later operation.

D. MALIGNANT DISEASE is usually cancer, which is found most often in the cecum or sigmoid flexure.   The condition may be evident as a developing obstruction, or by local pain, blood in the stools, or a mass which can be palpated.   Röntgen-ray examination will indicate a stricture or obstruction in the region of the colon which is involved.   Cancer of the colon is characterized by the fact that metastases occur late in the course of the disease, and that resection is followed by a high percentage of cures.

The **Rectum** and **Anus** include the lower twelve or fourteen inches of the colon which is attached to the sacrum, opening to the exterior at the anus.

Surgical lesions include: (A) Malformations.   (B) Ulcers, abscess, and fistula.   (C) Hemorrhoids and fissure.   (D) Cancer.

A. MALFORMATIONS.—"Imperforate anus," due to congenital defect, is a rare condition of the new-born, recognized soon after birth by the absence of meconium, or bowel movement.   The condition is incompatible with life unless prompt operative relief is successful.   This may consist of (1) colostomy, or (2) in some cases a perineal dissection can be made, the blind end of the colon reached, and brought down to the anus.

B. ULCERS of the rectum occur as in other parts of the colon, or associated with similar lesions throughout the large intestine

as a "colitis." They may be due to bacterial infection, broken-down gummata, polyps, or malignant growths.

Effects are: Painful and frequent defecation, blood, mucus, or pus in the stools, constriction with ribbon stools, or obstruction. The nature of the lesion can often be discovered by direct examination with a proctoscope. Treatment is local with applications or irrigations. In cases of stricture or malignant growth appropriate operative measures will be indicated.

ABSCESS, usually "perirectal" abscess, is a subacute process developing in the loose perirectal fat. This infection usually takes place from the skin or from hemorrhoids, and may reach considerable size, with comparatively little systemic reaction, on account of the poor local blood-supply. Even after free incision there is a marked tendency for the condition to become chronic, with a persisting sinus, due to secondary infection with staphylococci, B. coli, and, not infrequently, tubercle bacillus.

"FISTULA IN ANO" is the most frequent complication, due to an extension of the abscess into the rectum above the sphincter muscle, and through the skin to the surface. This may consist of a simple, fairly direct fistulous tract, but more often has several openings into the rectum and also to the surface, the tortuous canals lined with infected granulations. There is no tendency to spontaneous closure of such fistulous communications, and these persist indefinitely in spite of local treatment.

Principles of treatment depend on the early recognition of a perirectal abscess and prompt radical surgical treatment, free incision and packing to insure thorough healing from the bottom of the cavity. Persisting sinuses and fistulas require radical surgical operation, excision of the tract and packing the canal with gauze to secure complete healing with no pockets.

C. HEMORRHOIDS AND FISSURE.—Hemorrhoids consist of varicose dilatations of the hemorrhoidal veins which supply the rectum. "Internal hemorrhoids" are formed by such vascular tumors under the mucosa, and project into the rectum just above the sphincter muscle. "External hemorrhoids" are due to a similar condition of the veins under the skin in the region about the anus.

Causes.—(1) Habitual constipation and straining at stool, by mechanical effect cause dilatation of the hemorrhoidal veins and weakening of the vascular wall, and are the most important

factors in the etiology of hemorrhoids. (2) Obstruction of the pelvic veins by pressure of tumors, or a pregnant uterus. (3) Occupations requiring long standing, heavy lifting, or repeated straining. (4) Constitutional defects, weak vascular walls and supporting tissue about the rectum, which sometimes amounts to a family tendency. (5) Obstruction to the portal circulation, as in cirrhosis of the liver.

Complications.—(1) Protrusion of the hemorrhoids through the sphincter, "hemorrhoids coming down," resulting in pain and discomfort, usually relieved by rest in bed, local applications, or careful manipulations. (2) Hemorrhage, "bleeding piles," from rupture of the vascular swellings, may be profuse and frequently repeated, often resulting in serious anemia. (3) Itching and pruritis about the anus and perineum, due to irritating secretion. (4) "Fissures" and cracks in the rectal mucosa at the sphincter, causing severe pain at defecation. This is usually associated with hemorrhoids and is relieved by complete dilatation of the sphincter ani muscle, and cauterization of the base of the fissure. (5) Thrombosis of a dilated vein may occur independently of or associated with *infection* of a hemorrhoid, forming a hard, extremely painful tumor. An ice-bag, cold compresses, or opium suppositories may give temporary relief, but surgical incision, with the evacuation of a septic thrombus, is usually necessary. (6) Perirectal abscess may originate from an infected hemorrhoid.

The complaint of hemorrhoids, or "piles," is a common one, and in all cases thorough examination is indicated to exclude the presence of a serious lesion, particularly cancer of the rectum or sigmoid.

Principles of Treatment.—(1) Palliative, relief of constipation by diet, mineral oil, or drugs, to secure soft, semi-fluid evacuations and prevent straining. Local treatment of fissure or thrombosed hemorrhoids is indicated, since these tend to produce constipation on account of pain. Rest in bed and local applications after bowel movement may be necessary to prevent congestion and protrusion of hemorrhoids. Local salves and applications greatly relieve distressing symptoms, but rarely effect a cure. However, these with correction of causal factors will do much to render the condition endurable. (2) Radical cure by operation represents the method of choice in

persisting cases or where there are complications, especially
bleeding. Simple cases may be done under local anæsthesia
with comparatively little discomfort, but extensive involve-
ment usually requires general anæsthesia. Various types of
operations are indicated for special cases or are selected by
individual surgeons. Careful after-treatment is necessary to
overcome constipation or other predisposing cause and pre-
vent recurrence.

D. CANCER of the rectum. Next to the stomach, the rec-
tum is the most frequent site of malignant disease of the gas-
tro-intestinal tract. Many of the cases are mistaken for hem-
orrhoids till proctoscopic examination shows an advanced
lesion. Effects are: Local pain, especially at defecation, blood,
mucus, or pus in the stools, constriction of the rectum with
ribbon stools. The diagnosis is usually made by rectal and
proctoscopic examination. Prompt radical operation is indi-
cated, and, if done early, offers a reasonably good prognosis,
since metastases occur comparatively late in the course of the
disease. When these are found in the liver, the prognosis is
hopeless. Operation consists of complete excision of the rectum
involved: (1) Through the perineum, and the sigmoid above is
brought down to the surface at the anus. (2) By a prelim-
inary abdominal operation to exclude the presence of metas-
tases, and possibly to establish an artificial anus, followed by
excision of the rectum through the perineum. In order to secure
complete removal of the new-growth, it is often necessary to
establish a permanent fecal fistula by colostomy. Such a pro-
cedure allows more radical removal of the cancer and gives
greater security against recurrence. A properly arranged col-
ostomy can be made with a perfect sphincter permitting of reg-
ular bowel movements and no soiling. It may be accepted
by the patient with assurance that there will be very little
inconvenience.

The Vermiform Appendix.—(Fig. 41. See Anatomy and
Physiology.) This organ represents a direct continuation of
the cecum, which it resembles in structure, and has its own
mesentery carrying the blood and lymph vessels. The wall
is unusually rich in lymphatic structure, while the lumen is
lined with columnar epithelium, and normally is patent. Con-
genital or inflammatory constriction may cause: (1) Stasis of

contents in the lumen, resulting in "appendiceal coli," due to peristaltic efforts to empty itself, or (2) the formation of fecal concretions, "fecoliths," and a tendency to local inflammation.

Surgical lesions of the appendix include:

A. Inflammations:
  1. Acute
    a. Catarrhal.
    b. Suppurative.
    c. Perforations.
  2. Chronic appendicitis.

B. Tumors:
  1. Mucocele.
  2. Cancer.

FIG. 41.—Colon, ileo-cecal region, and appendix.

A. INFLAMMATIONS of the appendix represent the most common acute surgical lesion of the abdomen and are described clinically under several more or less distinct forms, which are all different stages of an inflammatory lesion. All acute attacks are associated with severe abdominal pain, vomiting, local tenderness, and muscle rigidity in the right iliac region, and usually with fever and leucocytosis. Recognition of the exact pathological change in the appendix, or prediction of the probable outcome from clinical observation, is rarely possible with any degree of certainty. Therefore most surgeons advise immediate operation as early as a diagnosis of acute appendicitis is

made. Simple cases often progress rapidly and develop serious, if not fatal, complications while under careful observation with surprisingly little clinical evidence. This is particularly true if the pain, which is the best indication of serious disturbance, is masked by morphine, or if fluids or cathartics have been given by mouth, stimulating peristalsis and interfering with nature's attempt to limit the infection.

TYPES.—(1) *Acute catarrhal appendicitis* consists of acute inflammatory changes in the lumen or wall of the appendix, but with no actual suppuration or pus formation. Possible effects are: (*a*) Changes in the structure of the appendix which predispose to further trouble; (*b*) rapid progress to the stage of suppuration. The clinical evidences are usually comparatively mild and subside within a few days. Light attacks are often unrecognized, or are not sufficiently severe to call a physician. However, they are important in the history of cases where there is subsequent disturbance suggesting a lesion of the appendix.

(2) *Acute suppurating appendicitis* is characterized by destruction of tissue and the formation of pus in the wall or lumen of the appendix. Results: Under favorable circumstances the condition may be self-limited even at this stage, but permanent changes in the organ occur, leading to chronic or recurring gastro-intestinal disturbances, known clinically as "chronic appendicitis." The more frequent outcome is rapid progress to the gangrenous destruction of the wall, and

(3) *Perforating appendicitis*, with local or general peritonitis. Clinical evidences of suppurating appendicitis include persistence of pain, nausea and vomiting, marked local tenderness and muscle resistance, increase in fever, pulse-rate and leucocytosis.

Complications and Dangers.—Gangrenous perforation of the appendix and extension of the infection to the peritoneal cavity.

The most favorable forms of this extension occur: (*a*) When the appendix lies in certain positions. Example, outside of the cecum, where the septic material is localized by natural surroundings and is soon walled off by protective adhesions, forming a localized abscess. (*b*) The infection extends gradually, and protective adhesions of the omentum develop rapidly, thus limiting the process to a definitely localized area. In either case the process is a conservative one, and the protective adhesions

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represent an attempt to encapsulate and localize the septic area. If this be undisturbed by excessive peristalsis induced by food or cathartics, there will develop a well-localized abscess which can be treated surgically by incision and drainage. Extension and general peritonitis may develop spontaneously, as a result of active peristalsis, or by unwise operative manipulations, with disastrous results.

The more unfavorable form of extension occurs: (a) When there is sudden rupture of a gangrenous appendix and the septic material reaches the free peritoneal cavity in such a manner that there is no possibility of limiting the process by protective adhesions. This may also occur from breaking down and extension of a localized abscess. A general diffuse peritonitis results, due to virulent organisms, and renders the prognosis more unfavorable. (b) Late complications in neglected cases or in instances where localized abscesses are incompletely drained include: (i) Perinephritic or pelvic abscesses due to the collection of septic material by gravity. (ii) Liver abscess due to the extension of the sepsis through the portal veins or lymphatics (see p. 199.) (iii) General pyæmia, or continued sepsis, due to unrecognized or inaccessible foci of infection.

Principles of Treatment.—1. Palliative measures. It is to be understood that acute appendicitis is essentially a surgical lesion, and only in certain exceptions is it justifiable to delay suitable operation. These exceptions include: (a) Early cases where a reasonable diagnosis is not possible. (b) Certain late or neglected cases where a localized peritonitis is evidently being walled off, and surgical judgment indicates delay till a local appendiceal abscess can be more safely opened and drained. (c) Very mild attacks or instances where surgical relief is not accessible are often carried over the acute attack, and elective appendectomy performed later. In all such cases, the most important consideration is that nothing be done to aggravate the condition, or to mask significant symptoms which indicate serious extension or complications, as peritonitis. (See p. 169.)

Cathartics by mouth are most dangerous and should be withheld in all suspicious cases. It has been said that all cases which develop fatal peritonitis have received cathartics early in the attack. Fluids by mouth are also contraindicated on the same basis on account of acute peristalsis. Morphine for

pain is to be used only on the direct order of the surgeon, and preferably only after a diagnosis has been made and operation arranged. Otherwise the condition is best handled on the principles outlined for beginning peritonitis. (See p. 169).

Mild attacks are frequently carried over the acute stage and subside spontaneously, but it is never possible for the surgeon to estimate accurately the pathological changes which have already taken place, or to predict the probable outcome with any degree of certainty. Many cases which recover the primary attack are left with a permanently damaged appendix which gives rise to recurrent disturbance, or later, to more serious attacks.

2. *Surgical Measures.*—(*a*) Simple appendectomy is usually possible in the early cases where the infection is limited to the lumen or wall of the appendix. This should be followed by an uncomplicated convalescence, and the laparotomy wound should heal by first intention. (*b*) Drainage of localized abscesses is necessary in cases which are seen later after the process has extended to the peritoneum, at which time the appendix is removed if this be reasonably possible. At this stage the essential lesion is a localized peritonitis which must be effectually drained, while the diseased appendix may be inaccessible, and therefore is left for a subsequent operation. If drainage is successful the condition should improve progressively. Persistence or recurrence of toxic symptoms is evidence that drainage is ineffective, or that other foci of infection are present and not draining. (*c*) Advanced cases with general peritonitis are treated on principles already outlined. (See p. 170). (*d*) Interval appendectomy between attacks may be indicated: (i) Patients who have had one or more definite acute attacks of appendicitis. (ii) The "chronic appendix." (iii) When the abdomen is opened for other purposes and the condition of the patient does not contraindicate the slight added procedure.

Post-operative complications of special interest:

1. Continued sepsis and fever may be due to: (*a*) Unrecognized foci of infection; (*b*) imperfect drainage; (*c*) wound infection. It calls for careful examination by the surgeon, possibly rearrangement of the drainage, further exploration of the wound, special positions (Fowler's), proctoclysis, and general treatment.

2. Fecal fistula, due to sloughing through the cecum into the laparotomy wound, may occur during the first few days after operation, accompanied by profuse fecal discharge. Spontaneous closure is the rule within a few weeks unless there is obstruction of the colon, or the wound is kept open by drainage.

3. Post-operative hernia from incomplete healing of a wound which has been drained is not uncommon.

" *Chronic appendicitis*" in the exact sense should be limited to cases where there has been one or more definite acute attacks with the classical symptoms.   In such instances the appendix will show positive evidence of previous inflammation; adhesions to surrounding structures, thickening of the wall, and constriction, with, or without suppuration.   Such conditions may cause persistent or recurrent symptoms, namely: local pain, tenderness, and digestive disturbance; predispose to subsequent more severe attacks of acute appendicitis; or possibly be a factor in the etiology of remote lesions in the abdomen; cholecystitis, gastric ulcer, etc.   In such cases the diagnosis is usually definite, and the indication for *appendectomy*, to relieve symptoms and to remove a source of danger, is perfectly clear. When done as an "Interval operation" (i. e. between acute attacks), the procedure is relatively safe, complications are few and unimportant, and results are satisfactory.

In addition to this reasonably definite group of cases, there are a large number of individuals suffering from persistent or recurrent abdominal pain, rightsided tenderness, and digestive disturbances, who are given a diagnosis of chronic appendicitis. The diagnosis in this type of patient is often obscure and the physician has to consider a number of possibilities, including lesions of the right kidney or ureter, right tube or ovary, gallbladder, or causes more remote.   Careful study and observation is usually necessary, and the diagnosis may have to be reserved for exploratory operation in persistent cases.   The appendix may show changes due to errors in development, or resulting from low grade inflammation which has never been made clinically evident by typical symptoms.   One may find an anatomically deformed appendix kinked, with the lumen partially obliterated, allowing a stasis of fecal contents and formation of concentrations of "fecoliths."   This condition causes pain and colic, and reflex digestive disturbances.   Again there

may be found membranes and adhesions resulting from congenital malformation or chronic inflammation resulting in constrictions and deformities. In a few cases the operator will find a beginning tubercular peritonitis.   In a number the appendix will appear of normal size, structure, and mobility and show no apparent pathology to explain the symptoms.   In all such doubtful instances it is necessary to explore the abdomen thoroughly at operation to discover and treat the causal lesion.

B. TUMORS of the appendix include: 1. Cysts, usually due to the retention of secretion, caused by constriction at the base.

2. Cancer of the appendix is an occasional finding at operation.   There are no characteristic symptoms by which such a lesion can be recognized clinically. Local pain, tenderness, and gastro-intestinal disturbance will suggest some lesion in this region, but the condition is often discovered at exploratory laparotomy or abdominal operation for other cause.

DEMONSTRATIONS

1. Demonstration of gastro-intestinal tract, anatomical chart.
2. Histories, cases of acute gastritis with explanation of causes.
3. Histories of cases of chronic indigestion.
4. Case history of congenital pyloric stenosis, with illustration.
5. X-ray pictures: hour-glass stomach, and pyloric obstruction.
6. X-ray picture showing foreign body in the stomach.
7. History of gastric ulcer with complications.
8. Laboratory test demonstrating "occult blood."
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10. History of case of ruptured gastric ulcer.
11. Statistics showing relation of gastric ulcer to gastric cancer.
12. Study of diet lists and medical treatment of gastric ulcer.
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17. Case history of post-operative fecal fistula, demonstration of apparatus and dressings for care of colostomy for cancer of rectum.
18. X-ray plates showing diverticulum of sigmoid, also of perirectal abscess injected with bismuth.
19. Demonstration, proctoscopic examination, showing ulcers, polyps, etc.
20. Case demonstration, "fistulo in ano."
21. Cases of hemorrhoids, local treatments and applications.
22. Case histories and charts showing types of appendicitis and complications.

CHAPTER XIII

THE LIVER, BILE PASSAGES, PANCREAS, AND SPLEEN

THE **Liver.**—(A) Anatomical and physiological consider-
ations: (1) Portal circulation, obstruction; (2) lymphatic
drainage and infections; (3) relations. (B) Surgical lesions:
(1) Wounds; (2) abscess; (3) cancer; (4) gumma.

The liver is a glandular structure located in the right hypo-
chondrium and epigastrium. Through the portal circulation it
receives various substances absorbed from the gastro-intestinal
tract, and plays an important rôle in the assimilation of car-
bohydrates and proteids. Its principal external secretion, the
bile, is formed from the blood in the liver cells, and carried
through the bile-ducts to the intestinal tract. Disturbances in
function of the liver cause more or less definite constitutional
and metabolic results, and may give rise to serious post-operative
complications: acidosis, post-operative vomiting, or late chlo-
roform poisoning.

A. ANATOMICAL AND SURGICAL RELATIONS.—1. The portal
circulation receives the blood from the entire gastro-intestinal
tract, pancreas, and spleen. Obstruction of the portal vein or
capillaries in the liver results in stasis of blood in the intestinal
tract and peritoneum.

Causes.—(*a*) Passive congestion of the liver due to "broken
compensation of the heart." (*b*) Cirrhosis of the liver, a patho-
logical condition characterized by development of fibrous tissue
about the portal capillaries and interference with the portal
circulation. (*c*) Pressure of tumors or new-growths on the
portal vein.

Results.—(*a*) Stasis of blood in the gastric and mesenteric
veins. (*b*) Ascites, collection of free fluid in the peritoneal cav-
ity. (*c*) Development of collateral circulation between branches
of the portal veins and certain systemic veins, establishing a
partial compensation: (i) At the cardiac end of the stomach.
(ii) Between the superior and middle hemorrhoidals. (iii) Su-
perficial abdominal, epigastric, and hypogastric veins with the
deep vessels. Such veins become dilated and varicose and may

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rupture with serious hemorrhage, or persist as varicosities or hemorrhoids. *Principles of Treatment* (see Ascites, p. 167).— Medical treatment of the causal conditions is indicated. "Tapping" with a trocar under aseptic precautions gives temporary relief, but the fluid rapidly re-accumulates. Radical operations have been suggested, which attempt to form an anastomosis between the portal vein and inferior vena-cava, or between the omental vessels and systemic circulation.

2. The portal vein carrying venous blood from the gastrointestinal tract, pancreas, and liver, and the lymphatic vessels from these regions, pass through the liver. Therefore sepsis or malignant disease of these organs is followed eventually by secondary foci; abscess, or cancer in the liver.

3. The upper surface of the liver lies in immediate contact with the diaphragm. Therefore liver abscess may extend, resulting in empyema of the pleural cavity, or infection of the mediastinum.

B. SURGICAL LESIONS of the liver include: (1) Wounds, (2) abscess, (3) cancer, (4) gumma.

1. *Wounds.*—Stab-wounds or traumatic rupture are associated with free hemorrhage into the peritoneum. Repair of wounds of the liver is exceedingly difficult, since sutures cut through the friable liver substance.

2. *Abscess* is usually secondary to infections in the area tributary to the portal circulation or lymphatic drainage. Example, appendicitis. There may be a single large abscess, or a number of smaller ones scattered through the liver substance. Evidences of liver abscess: Continued fever and sepsis, enlarged liver, and local tenderness. Clinical recognition of the condition is often difficult. *Significance* and *prognosis:* A single abscess, accessible to surgical drainage and promptly treated, commonly heals completely, but multiple abscesses indicate low general resistance, often being accompanied by pyæmia and metastatic abscesses in other parts of the body, so that surgical treatment is out of the question.

Principles of Treatment.—(a) The original lesion (example, appendix abscess) is to be opened and drained. (b) A large, single liver abscess can usually be successfully evacuated and drained. Multiple abscesses are not all accessible, and indicate a hopeless pyæmia.

3. *Cancer* of the liver is rarely primary in that organ. It is usually present as multiple nodules which are metastases from a primary growth in other organs, intestinal tract, or peritoneal cavity. The finding of such multiple nodules in the liver at exploratory operation is conclusive evidence that the original growth is inoperable.

4. *Gumma* of the liver, due to syphilis, causes constitutional evidence of the disease, and irregular enlargement of the liver, or localized tumor formation. It is not a surgical condition but may be mistaken for abscess or new-growth. Special antisyphilitic treatment is followed by definite improvement.

The **Bile passages** (see Fig. 42) include: the hepatic duct, cystic duct, gall-bladder and common bile duct, which opens in connection with the pancreatic duct, into the duodenum at the diverticulum of Vater. The bile is secreted in the liver cells, collected by the bile capillaries, and passes into the hepatic duct. The cystic duct and gall-bladder serve two functions: (a) As a reservoir where the bile is stored and emptied into the common bile-duct and duodenum, in response to certain stimuli. (b) The mucous membrane of the gall-bladder secretes mucous and substances giving the bile its normal consistency, and holding the cholesterin and bile-salts in solution. The common bile-duct opens into the duodenum at the diverticulum or ampulla of Vater, in common with the pancreatic duct. (See Fig. 42.) This relationship is important, since occlusion of the intestinal opening may result in the regurgitation of normal or infected bile into the pancreas, causing lesions of that organ. The common bile-duct passes in close relation to the head of the pancreas, and may be obstructed by tumors or enlargements of that organ.

"Jaundice" or "icterus" is one of the most important clinical conditions associated with lesions of the bile-passages. It is due to retention within the liver of the "bile pigments" which are normally excreted in the bile and carried to the intestinal tract. Under certain pathological conditions, these substances are retained in the liver cells, taken up by the systemic circulation, and deposited in various tissues of the body.

Causes.—1. Obstruction of the common bile-duct or hepatic duct by: (a) Inflammatory swelling in connection with similar conditions in the intestinal tract. "Catarrhal jaundice" is

gradual in development and subsides spontaneously as the underlying condition clears. (b) Obstruction of the common duct by stone, usually preceded by evidence of gall-stones in the gall-bladder or cystic duct. Complete obstruction of the common duct by stone is rarely of long standing, but the jaundice will recur intermittently till the calculus is removed or passed into the duodenum. A calculus in the ampulla of Vater is character-
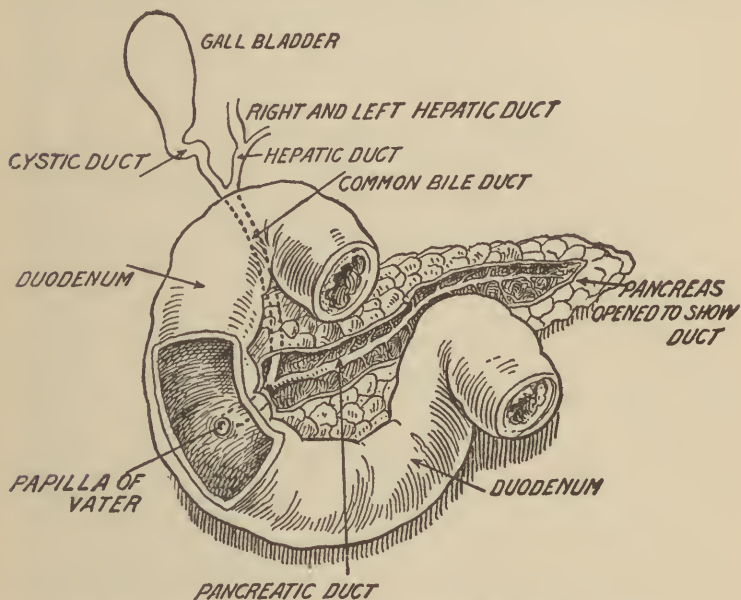
FIG. 42.—Relations of bile-passages, duodenum, and head of pancreas.

ized by intermittent jaundice and possibly chills or sepsis. (c) External pressure by tumors or growths, particularly in the head of the pancreas, results in persistent jaundice of the most extreme type.

2. Certain types of cirrhosis of the liver and other forms of constitutional disease are less common causes of persistent jaundice.

Evidences and Effects.—1. Pigmentation of the skin, at first a light yellow, later a bright lemon color, and finally an olive green, in long-standing cases.

2. Pigmentation of the sclerotic coat of the eye is often an early sign of beginning jaundice.

3. Clay colored stools, due to the absence of bile pigments in the intestinal tract.

4. High colored urine from the presence of bile pigments excreted from the circulating blood by the kidneys.

5. "Pruritis," persistent itching, is usually present.

6. "Cholæmia," changes in the blood due to the retention of bile retarding the coagulation time and predisposing to persistent hemorrhage, which is not easily controlled. This may contraindicate surgical operation till the condition is corrected by proper treatment.

Jaundice, either present or remote, is always an important symptom in the recognition of lesions of the bile passages. Treatment is directed at the underlying condition, in any case.

Surgical lesions of the gall-bladder and bile-ducts include: (A) Infections, "cholecystitis;" (B) "gall-stones," cholelithiasis; (C) cancer.

A. INFECTIONS.—1. *Acute cholecystitis*, involving the mucous membrane of the gall-bladder, is secondary to more or less remote inflammatory lesions of other structures, particularly the intestinal tract. (Examples: typhoid, appendicitis.) The onset is sudden with: (*a*) Evidences of sepsis, fever, and leucocytosis. (*b*) Abdominal pain, local tenderness, and muscle rigidity. (*c*) Gastro-intestinal symptoms, nausea, and vomiting. The course is progressive, but usually subsides in one or two weeks.

Complications are: (*a*) Severe sepsis and toxæmia. (*b*) Perforation of the gall-bladder, resulting in: (i) Local adhesions and persistent disturbance. (ii) Sudden rupture and severe general peritonitis. (*c*) Permanent inflammatory changes in the gall-bladder or cystic duct resulting in stasis of bile, recurrent attacks of subacute cholecystitis, or formation of gall-stones.

Principles of Treatment.—During the acute attack this is usually limited to palliative measures, operation being reserved for a later stage, except in the presence of certain conditions: severe sepsis or perforation and general peritonitis. Palliative treatment includes: Rest in bed, ice-bag locally, limitation of foods and fluids by mouth, especially in case of nausea and vomiting, and certain medicines as ordered. Surgical treat-

ment may be indicated as follows: (a) Cholecystostomy, temporary drainage of the gall-bladder. (b) Laparotomy and drainage of a general peritonitis as an emergency operation in case of rupture of a distended septic gall-bladder. (c) Cholecystectomy, removal of a damaged gall-bladder, usually after the acute attack has passed.

2. *Chronic cholecystitis* associated with inflammatory changes in the gall-bladder is not infrequent following an acute attack, and also occurs in cases where there is no definite history of a previous acute process. Chronic cholecystitis may present a variety of clinical symptoms: (a) Recurrent attacks of local pain, abdominal distress, and subacute symptoms. (b) Chronic or recurrent gastro-intestinal disturbances characterized by gaseous indigestion, pain after eating, especially after eating certain foods (fats), and constipation. (c) Evidences of "cholelithiasis," recurrent attacks of gall-stone colic, which is a significant indication of chronic trouble in the gall-bladder. (d) Recurrent attacks of fever and sepsis of obscure origin. (e) Remote constitutional symptoms or metabolic disturbances due to a secondary effect on the pancreas.

Principles of Treatment.—General or medical treatment, with dietary restrictions, is indicated during an acute process, but has little curative influence when there is organic change in the gall-bladder or bile-passages. Surgery is indicated: (a) To relieve chronic or recurrent disturbance. (b) In obscure cases to establish a diagnosis, relieve the cause, and exclude cancer. Operation consists of: (i) Cholecystostomy and drainage, or (ii) cholecystectomy in certain cases.

B. CHOLELITHIASIS.—"Gall-stones" consist of concretions or calculi of bile salts and cholesterin which are normally held in solution by the bile, but under certain conditions are deposited in the gall-bladder.

Predisposing causes: Infection of the gall-bladder, resulting in destruction of mucous membrane, or constriction of the cystic duct, causing stasis of bile. It happens not infrequently that the preceding cholecystitis is remote or indefinite, and is evident only as recurrent gastro-intestinal disturbances. Evidences: Gall-stones in the gall-bladder cause only symptoms of cholecystitis. Acute "gall-stone colic" is due to the passage of calculi through the narrow bile-ducts. The attack comes on

suddenly without immediate warning or premonitory symptom other than indigestion. The colic is characterized by acute stabbing pain under the right costal margin, usually radiating to the right shoulder. The duration is variable, a few hours, passing when the calculus reaches the duodenum. In case it lodges in the duct, the acute colic passes off to be followed by persistent local tenderness and distress. There may be dilatation of the gall-bladder, jaundice or cholecystitis, if the ducts are occluded by a calculus. Other symptoms include prostration, nausea, and vomiting, but no fever or sepsis unless there is cholecystitis.

After effects: (a) Recurrent attacks are common since there are usually chronic changes in the gall-bladder, predisposing to the formation of calculi though months or years may intervene. (b) Chronic cholecystitis is commonly present. (c) Destruction of the gall-bladder and ulceration of a stone into the intestinal tract occurs in rare instances. (d) Lodging of a stone in the common duct, or diverticulum of Vater, with intermittent jaundice and cholecystitis. (e) Regurgitation of bile into the substance of the pancreas and serious lesions of that organ. (f) Cancer of the gall-bladder or ducts, due to persistent irritation.

Principles of Treatment.—(1) Acute colic. Treatment is usually limited to relief of pain by efficient doses of morphine hypodermically, till the stone is passed into the duodenum. (2) Surgical treatment may be indicated: (a) In cases where there have been one or more acute attacks of colic, which is accepted as evidence of a lesion of the gall-bladder. (b) When a stone has lodged in the cystic or common duct. Operation will consist of: (a) Removal of the stone, usually with drainage of the gallbladder. (b) Cholecystectomy when indicated by permanent damage to the gall-bladder. (c) Removal of stones from the cystic or common duct, which is a more complicated procedure.

C. CANCER of the gall-bladder or bile-ducts is comparatively rare. There are no characteristic symptoms other than evidence of a serious lesion involving the bile-passages, persistent local pain and tenderness, chronic indigestion, or persistent jaundice which suggests occlusion of the bile-ducts, often from external pressure such as a tumor in the pancreas. In certain early cases complete removal is possible, but metastases are

frequently found in the liver, at the exploratory operation, which finding gives a hopeless prognosis.

The **Pancreas** is a glandular structure situated behind the stomach in the epigastrium and left hypochondrium.

Practical anatomical relations (see Fig. 42, p. 201): 1. The pancreatic duct opens into the duodenum with the common bile-duct in the ampulla, or diverticulum of Vater. Obstruction at this point by stone or new-growth may result in a regurgitation of bile into the substance of the pancreas. If the bile is actually septic, there often results an acute pancreatic abscess, or hemorrhagic pancreatitis. In other cases it causes a chronic pancreatitis with metabolic and constitutional effects.

2. The common bile-duct passes in close relation to the head of the pancreas and is often permanently occluded by tumors or cysts of that structure, resulting in a persistent high-grade jaundice.

3. Gastric ulcer perforating the posterior wall of the stomach may extend to and involve the substance of the pancreas.

Surgical Lesions.—(1) Acute abscess, or "hemorrhagic pancreatitis," is sudden in onset, characterized by most severe abdominal pain and prostration. There is fever, rapid pulse, and evidence of profound toxæmia and shock. Rupture to the free peritoneum occurs early in the course, usually with a rapidly fatal outcome. Clinical recognition of the exact condition is not always possible, but the picture is that of an acute abdominal emergency, calling for prompt surgical treatment. Adequate drainage of the abscess and general peritonitis presents the only hope of successful outcome. (2) Tumors, cysts, or cancer present no characteristic effects except those due to pressure: (*a*) A deep seated mass in the epigastrium. (*b*) Pressure on the common duct and jaundice when the head of the pancreas is involved. Cysts may often be successfully enucleated, but cancer is usually inoperable.

The **Spleen** is located in the left hypochondrium, behind and above the fundus of the stomach, in close relation to the diaphragm and the free peritoneal cavity. Its functions are not definitely understood but are associated with the blood-forming organs during embryonic life and early infancy. In adult life the spleen is involved in certain diseases of the blood-forming organs: bone-marrow and lymphatic tissues.

Surgical lesions include: (A) Rupture; (B) abscess; (C) enlargements; (D) relation to blood diseases.

A. *Rupture* due to external violence may occur in connection with crushing injury, especially when the spleen is enlarged or congested. Hemorrhage is profuse and may be fatal. It can be controlled only by prompt laparotomy, usually with splenectomy.

B. *Abscess* of the spleen may complicate certain infectious diseases, as typhoid, and demand surgical relief, drainage, or splenectomy. Rupture of an abscess of the spleen is followed by an intense diffuse peritonitis, for which surgical treatment is urgently indicated.

C. *Enlargements* of the spleen may be due to: (*a*) Acute general infections (typhoid), usually subsiding spontaneously with the disease. (*b*) Malaria, syphilis, and other more chronic infections, in which case the enlargement is of longer duration. (*c*) Circulatory disturbances, with "broken compensations" of the heart and chronic passive congestion in connection with a similar condition of the liver. (*d*) Myelogenous leukemia.

In these four conditions the splenic enlargement is more or less compensatory, and treatment is usually directed towards the underlying cause. (*e*) Tumors and abscess of the spleen are rare, but splenectomy may be indicated in certain cases.

D. *Certain blood diseases.* "Splenic anæmia," Banti's disease, and pernicious anemia, are associated with characteristic pathological changes in the spleen which are considered by some pathologists as causing the clinical condition. In selected cases splenectomy is done and is followed by definite improvement.

DEMONSTRATIONS

1. Demonstration of collateral circulation, case cirrhosis of the liver.
2. History and temperature chart of case of liver abscess.
3. History of a case of secondary cancer of the liver with report of autopsy findings.
4. Case of jaundice with demonstration of pigementation, skin and sclera. Demonstration of bile in the urine and "clay-stools."
5. Cases or histories of jaundice with explanation of cause and result of treatment.
6. History of case of acute cholecystitis.
7. Histories or cases of chronic cholecystitis with or without stones.
8. Demonstration of specimens of gall-stones. Study case histories.
9. Case histories cancer of gall-bladder.
10. Case histories: acute pancreatitis, tumors of pancreas.
11. Case showing abdominal tumor enlarged spleen, from any cause.
12. Histories showing effect of splenectomy, various causes.

THE URINARY TRACT: KIDNEYS, URETERS, BLAD-DER, URETHRA

THE **Kidneys.**—(A) Malformations, displacements, wounds. (B) Infection, acute and chronic. (C) Calculi. (D) Tumors.

The kidneys are located on each side of the lower thoracic and upper lumbar vertebræ, surrounded and supported by a definite fatty capsule. (Fig. 43.) The urine is secreted through the glomeruli and uriniferous tubules of the kidney substance, and carried by the various collecting tubules to the hilum or "pelvis" of the kidney. (Fig. 44.) The ureter is continuous with the pelvis of the kidney at its lowest point so that normally there is no stasis of urine, though this is a frequent occurrence in pathological conditions.

A. MALFORMATIONS, DIS-PLACEMENTS AND WOUNDS. —(1) Congenital anomaly of shape or position of the kidneys is comparatively rare, but may be extremely im-

FIG. 43.—Diagram of urinary organs.

portant. There are several possibilities: (a) Fusion of the two kidneys, "horseshoe kidney," with one or two ureters. (b) Absence of one kidney with an enlarged, hypertrophied opposite organ. (c) Displacement of one or both kidneys, or of

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a fused organ, which may be discovered as a pelvic mass and mistaken for a tumor.

Clinical evidence is rarely suggestive, and the condition is most often discovered at exploratory operation or autopsy. Catheterizing the ureters, and especially X-ray examinations after catheterization of the ureters, give suggestive evidences. In rare instances such an anomalous kidney presents serious pathological changes and is removed without recognition of the anatomical condition. The result is likely to be deficient kidney substance for normal function, and death from uræmia.
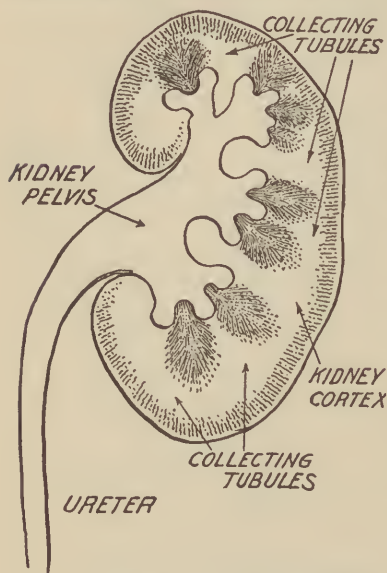
Fig. 44.—Pelvis of kidney, with collecting tubules, and origin of ureter.

2. *Atrophy* of a kidney sometimes follows sudden complete obstruction of the ureter, as in accidental ligation of a ureter during an extensive pelvic operation, and may occur with no suggestive symptoms, being compensated by hypertrophy of the opposite kidney. Destruction of one kidney by inflammatory disease is usually followed by compensatory hypertrophy of the opposite organ. Serious lesions may develop in such an hypertrophied and the remaining organ be removed. The individual is then left with no functioning kidney tissue, resulting in death within a few days. Preceding any operation likely to terminate in nephrectomy, it is necessary that exhaustive studies be carried out to determine the presence and functional capacity of the opposite kidney.

3. *Hydronephrosis*, a dilatation of the pelvis of the kidney, is usually the result of incomplete or intermittent obstruction of the ureter, and stasis of urine. This may be caused by: (a) Constriction of the ureter; (b) presence of a calculus; (c)

pressure of a tumor, or (d) lesions of the bladder. There results a dilatation of the kidney pelvis, compression and destruction of kidney tissue, and the formation of a tumor of considerable size.

Complications are infection, and formation of calculi or concretions. Indications for surgical treatment: An abdominal tumor, pressure symptoms, evidence of sepsis, or calculus formation.

Treatment includes: Removal of the obstruction, plastic operation on the ureter, reconstruction of the kidney pelvis, or nephrectomy.

4. *Displacement* of one or both kidneys may occur during adult life, with or without symptoms. Causes: (a) Congenital weakness of abdominal muscles and lack of intra-abdominal support, usually associated with "ptosis," or displacement of the abdominal organs, liver, stomach or colon. (See p. 160.) (b) Severe injury or falling. (c) Sudden or rapid loss of weight with absorption of the surrounding fatty capsule support. (d) Following pregnancy or weakening of the abdominal muscles. *Symptoms* are frequently absent and often are not characteristic: local pain and sense of weakness, presence of a movable tumor, pressure on other structures, possibly intermittent hydronephrosis with severe pain. Many cases are discovered accidentally in the course of an examination, and cause no effects which justify radical measures.

Principles of Treatment.—(a) Hygienic and constitutional measures to improve the general health, strengthen the tone of the abdominal muscles, and stimulate the development of the supporting structures. (b) Special belts and supports are used with success in many cases. (c) Surgical operation, fixation of the kidney to the posterior abdominal wall is indicated and successful in selected cases.

5. *Wounds* of the kidney occur from crushing injury, stab and gunshot wounds. Serious hemorrhage takes place which may require surgical control: suture, ligation of vessels, or nephrectomy. A hæmatoma may develop in the perirenal fat, and require evacuation. "Hæmaturia," blood in the urine, is a constant finding in all cases of serious injury to the kidney.

B. INFECTION of the kidney: 1. Acute processes are derived from one of two sources, secondary to foci of infection elsewhere in the body: (a) Metastatic infections through the blood stream

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associated with a more or less remote septic infection, tonsillitis, for example. (b) Ascending infection by way of the lumen or wall of the ureter is associated with infections of the bladder and stasis of urine.

(a) *Metastatic abscesses* in the kidney substance are obscure in development and often present but little characteristic evidence. There are constitutional reactions of sepsis: chills, fever, and leucocytosis. Locally there may be pain and tenderness, and possible suggestive urinary findings: albumen, pus-cells, and red-blood cells. In rare cases the causal bacteria are demon-
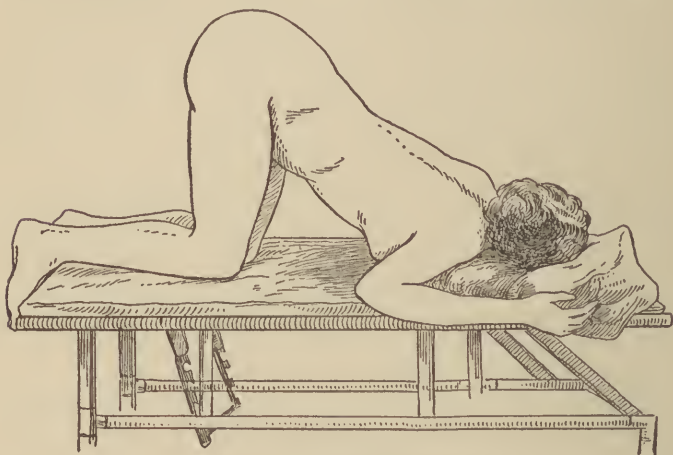
Fig. 45.—Knee-chest position.

strated in the urine or blood. Such an abscess may cause destruction of a kidney with comparatively little localizing evidence. Surgical exploration and treatment is indicated in cases where a diagnosis is reasonably definite, with drainage or nephrectomy: (i) to control sepsis; (ii) to prevent further destruction of kidney tissue.

(b) *Ascending infections* may complicate active infectious processes in the lower urinary tract, or develop obscurely under a variety of conditions. (i) Stasis of urine in the bladder and ureter due to an obstruction to the outflow, by enlarged prostate, or cystocele. Serious acute ascending infections are likely to follow extensively cystoscopic examination in some cases.

(ii) Partial or intermittent obstruction of a ureter with hydro-ureter and hydronephrosis. (iii) "Cystitis" and infections of the external meatus in children.

Effects: Pyelitis and inflammation of the pelvis, dilatation of the pelvis, with infected urine: hydronephrosis (see p. 208) and pyonephrosis (pus in the dilated kidney pelvis), with destruction of kidney tissue, and eventually, of the entire organ.

Constitutional symptoms are those of a low grade, subacute or intermittent sepsis, usually comparatively mild, but in certain cases there is a high grade of infection. Special evidence: local pain and tenderness, and possibly a palpable enlargement of the kidney. Urinary findings are characteristic: pus-cells,
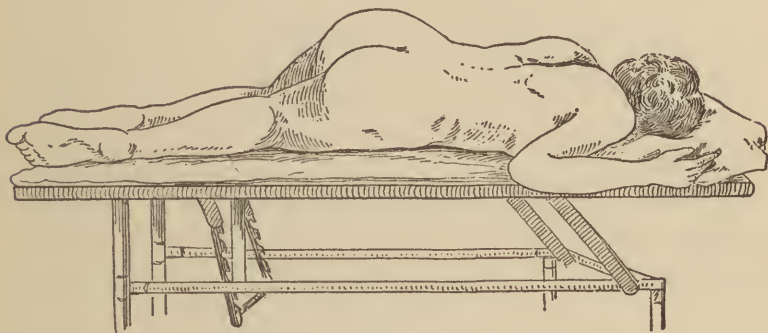
Fig. 46.—Sims's position.

red-blood cells, and, in some cases, the causal organisms can be isolated. Catheterization of the ureters may be indicated to confirm the diagnosis, to determine the condition of each kidney, and for special methods of treatment.

Principles of Treatment.—Constitutional measures for sepsis: fluids and diuretics to increase the secretion of urine and flush the kidney pelvis. "Urinary antiseptics": salol, hexamethylene, for their bactericidal effect.

Surgical measures are indicated in special cases: removal of any obstruction to the ureter where this is possible, in case of pelvic tumor or hydronephrosis; incision and drainage, or nephrectomy where there is severe sepsis, or destruction of the kidney

2. *Chronic, tuberculous* infections of the kidney while usually

secondary to similar lesions in other regions of the body, fre-
quently occur in individuals who show no clinical evidence of
such processes, and whose history gives no indication of previ-
ous disease. Tuberculosis of the urinary tract is primary in the
kidney and is usually limited to one organ for a considerable
period (months or years). It is first evident clinically as a
bladder irritation, characterized by painful and frequent mic-
turition with an acid urine, being frequently mistaken for cys-
titis. Careful microscopical examination of the urine will usually
demonstrate: a few pus-cells, red-blood cells, and tubercle
bacilli. In fairly advanced cases there may be lesions in the
bladder (ulcers), but these are secondary to the kidney infec-
tion and frequently clear up if the primary focus is removed.

Signs and evidences of renal tuberculosis include: (a) Per-
sistent bladder irritation with an acid urine. (b) Urinary find-
ings: usually no albumen and comparatively few pus-cells, but
there are red-blood cells, and tubercle bacilli demonstrated
in catheterized specimens of urine. (c) Ureteral catheterization
is indicated in suggestive cases: (i) to determine which kidney
is involved; (ii) to demonstrate the functional capacity of the
opposite organ, preceding nephrectomy. (d) When tubercle
bacilli cannot be demonstrated small amounts of urine are
injected into the peritoneum of guinea pigs, followed by the
development of characteristic tubercular lesions in these animals.
(e) Local pain, tenderness, and possibly a palpable tumor may
be present. (f) Constitutional evidence of tuberculosis: weak-
ness, loss of weight, fever, and night sweats are usually more or
less evident.

Principles of Treatment.—Early recognition is the first es-
sential. Cases of persistent bladder symptoms with a clear acid
urine, especially with suggestive constitutional evidences, call
for an intensive study. Preceding surgical treatment, it is nec-
essary to have: (i) exact diagnosis of the site of the lesion, and
(ii) knowledge of the functional capacity of the opposite kidney.
When the process is limited to one kidney, removal of that
organ is indicated, and is usually followed by good results.
Constitutional and specific, "tuberculin" therapy must be
continued for months and years to insure permanent cure.

C. URINARY CALCULI are formed from calcium, uric acid,
oxalic salts, and other substances which normally are held in

solution in the urine. Under pathological conditions, these salts may be deposited in the substance, or pelvis of the kidney, forming solid concretions or calculi.

Predisposing Causes.—1. Remote constitutional or metabolic disturbances, resulting in abnormal amounts of various salts in the urine, or altering the composition of the urine so that these substances are not held in solution.

2. Anatomical changes in the ureter or kidney pelvis, causing stasis of urine, and infection.

3. Infection, destruction of epithelium, forming necrotic tissue which acts as a foreign body, serving as a nucleus for the formation of calculi.

Effects and Symptoms.—1. Calculi in the substance of the kidney or pelvis cause: (*a*) Irritation and tissue destruction, local pain and tenderness which is persistent and tends to radiate to the inguinal region. Röntgen-ray plates show the shadow of most stones, and form an important diagnostic procedure. (*b*) Infection and pyelitis is a frequent complication. (*c*) Changes in the epithelium of the pelvis, due to persistent irritation, are believed to predispose to cancer. (*d*) Ureteral colic is caused by fragments of a calculus passing into the ureter, where they may lodge and cause a permanent occlusion. (*e*) Calculi are often retained in the bladder and form a nucleus for the development of stone in that organ.

2. *Ureteral colic*, due to the passage of stone in the ureter, is characterized by most intense, prostrating pain, radiating to the groin, and requires large doses of morphine to give relief. There may be temporary suppression of urine during the attack, which is usually of several hours duration. Constitutional evidences, aside from prostration, are usually absent unless there is infection of the kidney, or organic disease of that organ.

Principles of Treatment.—(*a*) Ureteral colic calls for relief of pain by adequate doses of morphine or inhalations of chloroform and hot applications or "stupes" locally. Such an attack is often the first indication of stone-formation in the kidney, and recurrence is likely at any time. (*b*) Surgical measures may be indicated by: (i) Evidence that the calculus has lodged in the ureter. (ii) Presence of other stones in the kidney demonstrated by the X-ray. (iii) Evidence of stone in the bladder.

Surgical measures include: (i) Exposure of the ureter and

removal of the stone. (ii) Removal of calculi from the kidney pelvis with plastic operation to prevent further stasis of urine, or drainage of the kidney for infection. (iii) Nephrectomy, when the kidney is extensively involved. (iv) Stones in the bladder (see later).

D. TUMORS OF THE KIDNEY.—Benign growths, except enlargement due to hypertrophy, hydronephrosis, or inflammation, are comparatively rare.

Malignant growths include two varieties:

1. *Hypernephroma*, an abnormal development of atypical tissue resembling fetal kidney or adrenal structure. There are no localizing signs or symptoms till the growth reaches considerable size, when it can be palpated and recognized as a kidney tumor. Metastatic growths occur relatively early and may present the first evidence of malignant disease, but give a hopeless prognosis. Surgical removal is indicated in case the growth is limited to the kidney.

2. *Cancer* of the kidney usually develops in the region of the hilum or pelvis. Special predisposing factors are irritations from calculus or sepsis. Early symptoms and signs are: local pain, blood in the urine, coming from one kidney, and later a palpable tumor. "Hæmaturia" is always an important finding and suggests the presence of a serious lesion, tuberculosis, calculus, or cancer, and indicates an intensive study of the case. Lymphatic involvement and metastases occur fairly late, and early nephrectomy offers a reasonable prognosis for cure.

The Ureters are mucous-lined ducts extending from the hilum of the kidney to the base of the bladder. The walls contain non-striated muscle fibres and the ureters have an active peristalsis which tends to carry solid substances to the bladder. The ureters extend behind the peritoneum into the pelvis, where they lie in close relation to certain blood-vessels, superior hemorrhoidal and uterine arteries, and may be injured or ligated in controlling bleeding from these vessels at surgical operations. They pass obliquely through the wall of the bladder in such a manner as to prevent regurgitation of urine. Calculi often lodge at this point.

A. ANATOMICAL ANOMALIES are rare, usually being discovered by cystoscopic examination. When present, they suggest the possibility of anomalous kidney structure or position.

B. INJURY to the ureter usually occurs during surgical operation, hysterectomy, or resection of the rectum.

1. Wounds may escape immediate notice, but are followed by leakage of urine into the pelvis with sepsis and sloughing of tissue. Prompt drainage gives temporary relief, and later suitable anastomosis may be made, or the ureter may be implanted into the bladder. In some cases nephrectomy may be necessary.

2. Ligation of the ureter is an occasional accident in connection with tying the uterine artery, resulting in complete obstruction of urine from the corresponding kidney. Provided the opposite organ is functionally competent, this may be followed by a symptomless atrophy of the involved kidney. In some cases nephrectomy may be necessary.

C. OBSTRUCTION of the ureter: (1) Complete occlusion results in a temporary hydronephrosis and finally atrophy of the kidney. (2) Partial obstruction or kinking of the ureter is followed by hydronephrosis, stasis of urine, pyelitis, sepsis, or calculus formation. Causes: Ligation or compression at operation, occlusion by calculus, constriction from ulceration, pressure of tumors.

Surgical treatment: Removal of the cause when possible, plastic operation to correct the deformity, removal of the kidney where there is serious infection.

D. INFECTIONS of the ureter are usually secondary to those of the kidney or bladder. (1) Tuberculosis of the kidney is followed by ulceration of the ureter, sometimes to the extent of occluding the lumen, and the tuberculous process may be isolated from the lower urinary tract. It is frequently necessary to remove a tuberculous ureter in the surgical treatment of renal tuberculosis.

2. Infections of the bladder with stasis of urine are followed by an ascending infection either in the wall or lumen of the ureter. There is commonly a stasis of urine in the ureter, "hydro-ureter," and later a pyelitis. Treatment is essentially that of the pyelitis and the causal condition.

The Bladder.—(A) Functional disturbances. (B) Surgical lesions.

The bladder, located in the true pelvis back of the symphisis pubis, lies partly in the loose fatty tissue of the pelvis,

and the upper part, "fundus," is covered by a reflection of the peritoneum so that it projects into the free peritoneal cavity. The bladder is described as a pear-shaped organ, with the upper part, "fundus," covered with peritoneum, and a base or "trigone" which receives the ureteral openings at its upper angles, and empties into the "urethra" at the lowest point.

A. FUNCTIONAL   DISTURBANCE. — (1) Incontinence.   (2) Retention.   (3) Residual urine.   Normal control of the bladder lies in the voluntary muscle or "sphincter" surrounding the upper part of the urethra, and is under voluntary control of the nervous system through a "nerve centre" in the lumbar region of the spinal cord.

1. *Incontinence* of urine is characterized by constant dribbling of urine, or involuntary micturition. It may be due to: (a) Paralysis of the sphincter from disease of the central nervous system: tabes, cerebral syphilis, or injuries to the centre in the spinal cord, fracture of the vertebral column.   (b) Mental deficiency, or deficient thyroid secretion.   (c) Injury to the sphincter or urethra from surgical operation or difficult obstetrical delivery. Repair is possible in most cases.   (d) "Paradoxical incontinence," with continued dribbling, due to atony of the bladder from overdistention, and retention of urine.   This condition is easily mistaken for a simple incontinence and the erroneous conclusion reached that the bladder is empty, when in fact it is tremendously overdistended.   Catheterization makes the diagnosis and usually relieves the condition, though it may have to be repeated.

2. *Retention of urine* may be due to: (a) "Anuria," lack of secretion of urine from constitutional causes, and catheterization demonstrates an empty bladder.   (b) In the male, mechanical obstruction of the urethra by "Stricture" or enlarged prostate. In the female: pelvic tumors, pregnancy, especially during labor, caruncles or painful ulcers of the urethra. (c) Temporary psychical influences. (d) Post-operative retention, due to: (i) Absence of secretion from lack of fluids; (ii) irritation from the operation; (iii) overdistention; (iv) inability to use a bed-pan or urinal in bed. The effects of a simple temporary retention, if properly relieved, are limited to infection or cystitis due to careless or repeated catheterization.

Principles of Treatment.—Palliative measures include; hot

stupes over the lower abdomen, "pitcher douches," enemas, hot sitz baths, and the sitting posture when this is possible. The catheter is to be reserved as a last resort, since even a single catheterization may set up a cystitis, and frequent repetition is almost sure to. This is especially true in cases of obstruction where there is residual urine in the bladder. In some cases with sudden obstruction the passage of the catheter may be quite difficult and do serious damage to the urethra. This occurs most often in the male, and these cases are usually cared for temporarily by the surgeon, followed by special treatment: dilatation of strictures, or operation to correct and remove the cause. In the female, except during labor, the glass or metal catheter is the simplest to sterilize and use. Good light and exposure of the urethral opening is necessary to avoid contaminating the sterile catheter by contact with the bedding or clothing.

3. Accumulation of *residual urine* in a pouch or sacculation of the bladder, which is not drained in ordinary micturition, may occur in certain types of obstruction of the urethra, or relaxation of the anterior vaginal wall, "cystocele."

Results are: (a) Stasis of urine; (b) cystitis; (c) calculus formation. Contamination of such a bladder by a septic catheter, or septic material carried up from the lower urinary tract, may be followed by an active cystitis, and severe, or fatal, ascending infection of the kidneys.

Principles of Treatment.—Whenever possible the cause must be corrected by suitable surgical operation. In other cases it is necessary to depend on regular aseptic catheterization to drain the residual urine.

B. SURGICAL LESIONS.—(1) Wounds. (2) Infections. (3) Calculus. (4) Tumors.

1. *Wounds.*—Injuries to the bladder may be caused by: (a) Penetrating wounds. (b) Crushing injury, especially with a distended bladder. (c) Fracture of the pelvis. (d) Difficult obstetrical delivery. (e) Accidents at surgical operations where the bladder is not empty, or has been displaced by pathological conditions, tumors, pelvic abscesses, or is present in a hernia. Effects: "Extravasation of urine": (i) Into the peritoneal cavity with peritonitis; (ii) into the surrounding connective tissue with cellulitis and sepsis.

The characteristic findings are: blood in the bladder; cath-
eterization a few hours later demonstrates that there is no
urine in the bladder. Evidences of peritonitis or sepsis are pres-
ent within twenty-four hours. Treatment consists of prompt
surgical measures: (i) To drain the infected tissues; (ii) to repair
the wound in the bladder.

Operations of the bladder: "Cystoscopy," the introduction
of a special instrument through the urethra which allows of
visual inspection of the bladder wall and contents, catheteri-
zation of the ureters, or certain operations. "Cystotomy" for
the removal of stones or new-growth may be (i) "supra-pubic,"
i.e., through the abdomen by extra-peritoneal exposure of the
bladder, (ii) "perineal" in the male, or rarely (iii) "vaginal"
in the female. "Cystostomy" for temporary drainage is usually
supra-pubic with special apparatus or tubes for collecting the
urine. A special "retention catheter" in the urethra is used in
certain conditions after bladder operations, for the repair of
wounds of that structure.

2. *Infections* of the bladder, "cystitis": (a) Secondary to
kidney tuberculosis as already considered, is characterized by
an acid irritating urine, comparatively clear of pus, but con-
taining red-blood cells and tubercle bacilli. Cystoscopic exam-
ination will demonstrate areas of ulceration, usually about the
affected ureter, and will enable the surgeon to collect the urine
from each kidney separately. This procedure is indicated in all
such persistent cases.

Principles of Treatment.—Control of the cause, *i.e.,* removal
of the tuberculous kidney when this is possible. In late cases
palliative measures, irrigations and instillations into the bladder
are used.

(b) Other types of cystitis are usually subacute and tend to
become chronic. They are characterized by: frequent mictu-
rition accompanied with pain, alkaline offensive urine, often
with an ammoniacal odor, and containing pus-cells, bladder
epithelium, crystals, and bacteria.

Causes: (a) A partial obstruction of the urethra. (b) Resid-
ual urine. (c) Urethritis (gonorrheal infections often compli-
cated by secondary infection with other organisms: B. coli).
(d) Careless catheterization.

Results and complications: Irritable bladder, lessened

capacity of that structure, infection of residual urine, ascending infection of the ureter and kidney, and calculus formation.

Principles of Treatment.—Medicinal: fluids and diuretics to increase the flow of urine and to alter the reaction. Urinary antiseptics. Irrigations and instillations in certain cases, or a permanent catheter. Surgical relief of urethral obstruction and drainage of residual urine is indicated, but in some cases a preliminary cystostomy is done for drainage till the condition of the patient improves.

3. *Calculi* of the bladder resemble those of the kidney in composition. Causes: (*a*) Retention of kidney calculi which have reached the bladder. (*b*) Residual urine with cystitis.

Symptoms: Pain, frequent micturition, with severe pain and bleeding at the completion, free blood in the urine. Symptoms are usually worse during the day when the patient is up and about.

Effects: Cystitis, pyelitis, increase in the size of the stone. Treatment is usually operative, removal of the stone by cystotomy. In selected cases, soft stones can be crushed by special instruments introduced through the urethra.

4. *New-growths* are usually derived from the epithelium of the bladder. (*a*) Benign "papillomas" are often multiple and hang freely in the bladder. In rare cases such tumors occlude the urethra and cause urinary obstruction. There are no characteristic symptoms of such tumors aside from bladder irritation and pain. The diagnosis is usually made by cystoscopic examination or exploratory cystotomy. Removal of benign polyps or papillomas may be accomplished by: (i) Electro-cautery or snare through the urethra, or (ii) by cystostomy.

(*b*) Malignant growth, cancer, is more often single, and is characterized by bleeding and pain. Examination by cystoscopy or cystostomy shows infiltration about the base of such a tumor and involvement of the bladder wall. Treatment: (i) Radical removal, with a free margin of bladder wall, and plastic reconstruction of the bladder. (ii) Removal is also successful by special forms of electrolysis in certain extensive cases.

Urethra.—The FEMALE URETHRA is short and easily accessible to examination and treatment.

1. Urethritis, gonorrheal, usually associated with lesions of the genital tract, is of short duration and accompanied with but

few complications of the urinary tract.   There is a type of ascending infection of the urethra, bladder, and ureter to the pelvis of the kidney, due to the B. coli or staphylococcus, not infrequent in children, especially girls.

2. Injuries due to difficult obstetrical operations are likely to cause temporary retention of urine from pain and irritation of the urethra.   More serious injury which involves the sphincter results in permanent incontinence.   Immediate repair relieves the pain and retention, and plastic reconstructive operation is indicated in cases of incontinence.

3. Urethral "caruncle" is a small, highly sensitive tumor of the female urethra found especially at the external "meatus." The condition is associated with painful micturition or slight bleeding, and is recognized by local examination.

Principles of Treatment.—Cautery by silver nitrate, or actual cautery and surgical removal.

4. Cancer of the urethra is comparatively rare, but is highly malignant and most often inoperable.

MALE URETHRA is longer and more complicated in structure. Inflammation, "urethritis," usually gonorrheal, is more persistent and difficult to eradicate.   Directly or indirectly the condition gives rise to several serious surgical lesions: peri-urethral abscess, stricture of the urethra, sudden retention of urine, and deep-seated perineal abscess.

The *prostate gland* surrounds the male urethra and base of the bladder.   It is subject to inflammatory enlargement, benign hypertrophy, or tumors, all of which conditions interfere mechanically with complete normal evacuation of the bladder. There then results accumulation of residual urine in the bladder, and the associated complications.   In certain cases showing mechanical disturbance, the enlarged prostate is removed by surgical operation.

DEMONSTRATIONS

1. Demonstration of urinary organs on anatomical chart.
2. Pictures showing anomalies of kidneys.
3. Specimen or pictures showing hydronephrosis with explanation of cause.
4. X-ray plate with ureters catheterized or injected with silver salts.
5. Case showing ptosis of kidney, demonstration of binders or supports.
6. Histories of surgical infections of kidney, with specimens or pictures.
7. Histories of pyelitis of pregnancy and in children.
8. Characteristic history of tubercular kidney with bladder symptoms.

9. Demonstration of methods of securing and labeling specimens from ureteral catheterization, laboratory technique of staining for T. B.
10. Methods of testing for kidney efficiency.
11. History of cases of kidney calculus, demonstration of specimens. Urine showing typical crystals.
12. X-ray plate showing calculus in kidney or ureter.
13. Case showing tumor of kidney, specimen or illustrations.
14. Demonstration of bladder on anatomical chart.
15. Case showing tumor from distended bladder, cases of urinary incontinence with explanation of cause.
16. Methods of treatment of incontinence.
17. Treatment of retention, preparation for and technique of catheterization.
18. Case of residual urine, explanation of cause, study or catheterized specimen.
19. Cases or histories of extravasation of urine.
20. After-care of cystostomy, retention catheter, technique of bladder irrigation.
21. Case histories of bladder tumors, also of stones.
22. Case or illustration showing urethral caruncle.

CHAPTER XV

SURGICAL LESIONS OF THE UTERUS, FALLOPIAN TUBES AND OVARIES

THIS subject, " Surgical Gynecology," is commonly treated by general surgeons in the surgical department of many hospitals. It is so intimately associated with surgery that a brief consideration of the more important conditions are here presented.

A short study of the structure and functions of the organs involved is necessary. The female generative organs include those peculiar to women and concerned in the functions of reproduction and menstruation. Considered as a tract or system there are : (a) two specialized sex glands, the *ovaries* in which the *ovum* is developed, and which supply important internal secretions. One ripened or matured ovum is thrown off at regular intervals into the free peritoneal cavity. (b) The paired Fallopian tubes which open freely into the peritoneal cavity and through which the mature ovum is carried on into the genital tract by the action of specialized ciliated epithelium. In the tubes it may either become fertilized by the male spermatozoa and subsequently lodged in the uterus or if this does not take place, it is carried through the uterus and vagina to the exterior. (c) The *uterus* which is specially adapted to expand and furnish nourishment to the fertilized ovum and fetus. (d) The *vagina* into which the uterus opens and which in turn communicates to the exterior through, (e) the External Genitals or " Vulva." Figures 47 and 48 show the general arrangement of the entire system, together with the relations to other structures. Figure 49 illustrates the external genitals.

In the normal non-pregnant woman, the internal genital organs are contained within the true pelvis. They are maintained in their normal positions and relations by two sets of structures : (a) a group of muscles and layers of fascia connective tissue forming the floor of the pelvis and also serving to support the bladder and rectum. These structures can not be here described in detail, but they are subject to serious injury during child-bearing. (b) Three pairs of " Ligaments of the uterus "

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attached to the pelvic wall. (i) The " Broad Ligaments," consisting of a continuation of the peritoneum covering the uterus and passing from the sides of the uterus to the wall of the true pelvis. This fold contains some non-striated muscle, the blood and lymph vessels, together with the nerve supply of the uterus, Fallopian tubes and ovaries. (ii) The " Round Ligaments " consisting of nonstriated muscle fibres surrounded by peritoneum,

Fig. 47
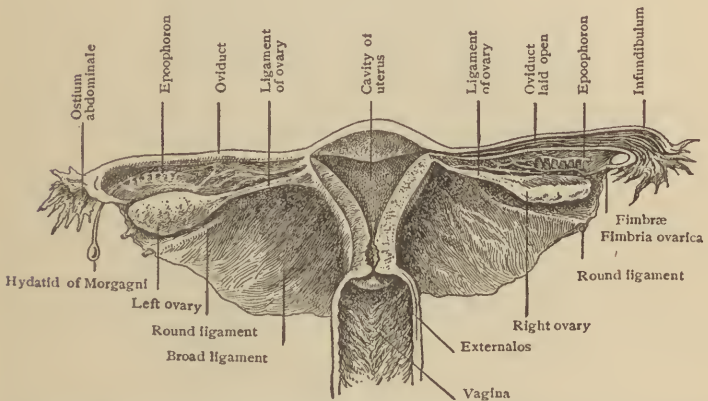
Broad ligaments, viewed from behind, have been stretched out and pinned, the posterior wall of uterus and vagina removed and right oviduct laid open. Ovaries do not occupy their normal position, their long axis here being horizontal instead of approximately vertical.

extending from the upper angle of the uterus to the anterior abdominal wall, through the " Internal " and " External Rings " of the obligue " Inguinal Canal," to be attached near the upper end of the Labia Majora. This Inguinal canal corresponds in general to the Inguinal canal in the male. (iii) The " Utero-sacral " ligaments consist of a fold of non-striated muscle covered by peritoneum and pass from the cervix of the uterus along the lateral wall of the pelvis to the sacrum. These sets of ligaments serve to limit free movement of the uterus, and extend in length to allow for increase in size during pregnancy. They also serve in some degree to maintain the normal position and

relations of the uterus to other pelvic structures. It is to be noted that many operations for correcting malpositions of the uterus are based upon some method of shortening or folding one or more pairs of these ligaments.

The *Ovaries* are a pair of specialized organs supported in the posterior layer of the broad ligaments by two pairs of special

FIG. 48.
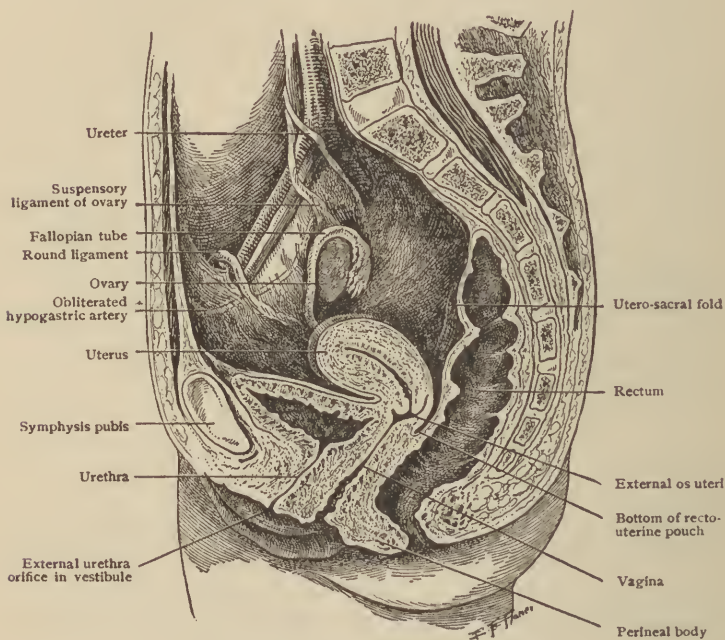
Sagittal section of pelvis of female.

ligaments: the " Utero-ovarian " from the uterus, and the " Ovarian " extending to the wall of the pelvis. The blood supply is comparatively rich and comes through: (*a*) the ovarian from the internal iliac artery, and (*b*) a branch of the uterine which also supplies the corresponding Fallopian tube.

The ovary is about 2 inches long, 1¼ wide and 1 in thickness. It consists of two sorts of tissue: (1) The " Stroma " and supporting tissue which is supposed to give rise to an im-

portant internal secretion. (2) Scattered through the stroma
are a large number of specialized cells, each of which represents
a potential ovum. During the period of sexual activity (from
about 14 to 45 years), at regular intervals of about 28 days one
ovum undergoes a process of development or " Maturation."

FIG. 49.
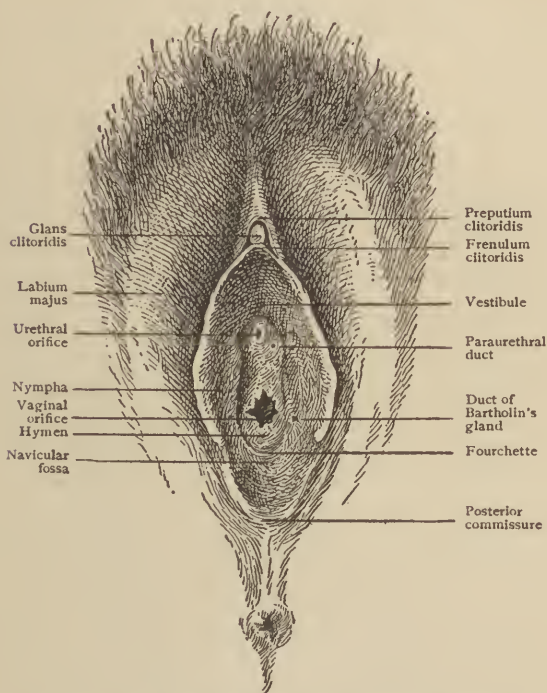
External genial organs of virgin; labia have been separated to expose vestibule
and vaginal orifice.

This process of ripening involves the development of a group of
cells surrounding the ovum and the formation of a typical
" Graffian follicle." At a definite time this follicle, having ap-
proached the surface of the ovary, ruptures allowing the mature
ovum to escape into the pelvic peritoneal cavity. The cells lining
the empty follicle undergo development and form a definite
structure, the " Corpus Luteum." This latter has certain spe-

cific functions: (a) Allows healing and filling in of the empty cavity without formation of scar tissue, which would in a short time replace the entire ovary, (b) The corpus luteum has an internal secretion which has a specific influence on the uterus during menstruation. The Corpus Luteum of early pregnancy persists for several months, and has an important effect on the development of the uterus and in stabilizing the pregnancy. Many abnormalities in development of the graffian follicles and corpus luteum masses may occur and give rise to certain types of Ovarian Cysts.

The *uterus* and *Fallopian tubes* represents a Y-shaped canal specially adapted to provide: (1) The transmission of the mature ovum from the peritoneal cavity to the proper site for impregnation. (2) The subsequent provision for the nutrition and development of the impregnated ovum, or (3) In the absence of impregnation, the unfertilized ovum is carried through the uterus and vagina to the exterior, associated more or less directly with the bloody menstrual flow. The uterus and tubes are lined with ciliated columnal epithelium, which provides a current of motion from the tubal opening in the peritoneum into the vagina. This epithelium or mucosa rests upon a highly vascular cellular submucosa, which during pregnancy undergoes marked development and in the uterus, forms a typical " Decidua," to provide for the implantation and nutrition of the fertilized ovum. The wall of the uterus is composed of several layers of non-striated muscle, which during pregnancy undergo development and allow tremendous increase in the size of the structure.

The Fallopian tubes contain in their walls a thin layer of the same sort of muscle, but not sufficient to allow for rapid increase in size of the lumen. Consequently the persistent development of an impregnated ovum in the tube is certain to result in disaster; either its expulsion, or the rupture of the tube wall, the " Ruptured Tubal Pregnancy." The Fallopian tubes and most of the uterus are covered with a fold of peritoneum forming the serous coat. Studied in cross-section there are three distinct layers: (1) The Serous which consists of the peritoneum, (2) The Muscular or Myometrium which in the tube is a thin layer of circular muscle bands, and in the uterus is about one inch in thickness, (3) The Mucosa or Endometrium consisting of (a) a vascular cellular submucous layer and (b) the

surface epithelium composed of columnar, ciliated cells. In the uterus there are a large number of tubular or branched glands extending from the surface epithelium into the cellular stroma. In the Fallopian tubes, the mucous lining is thrown into definite folds extending into the lumen. During menstruation and pregnancy, the endometrium undergoes marked hypertrophy.

In gross structure the Fallopian tubes extend from the cavity of the uterus through its musclature at the upper angles or ' Cornua " and are surrounded by a serous layer formed by folding of broad ligament. The tubes are normally about 3½ inches long by ⅓ inch in diameter, and are commonly described as consisting of three portions : (1) A relatively narrow " Isthmus " as it leaves the uterus, (2) a wider " Ampulla," and (3) a terminal " Fimbrinated " extremity. This portion is in close proximity to the ovary and opens freely into the peritoneal cavity. This rela-tionship is important in two respects : (1) It provides a channel for the transmission of the ovum into the uterus, (2) It also permits the extension of infections of the endometrium and tubes to extend into the peritoneal cavity.

The *uterus* resembles a flattened pear in shape. It is about 3½ inches in length, 2½ inches in width and 2 inches in thick-ness. The " Fundus " or body is the broad upper three-fourths, and the " Cervix " or neck is the narrow lower portion which opens into the vagina. The epithelial surfaces are normally in apposition so that the cavity contains only a slight mucous secre-tion. The cervical canal is continuous with the cavity of the fundus above at the " Internal Os " and opens into the Vagina through the " External Os." Normally, the uterus is tilted slightly forward or is " Anteverted " in close relation to the blad-der. In this position pressure from above on the uterus tends to force that organ down, but this tendency is limited by the bony symphysis pubes, thus preventing any marked falling or " Pro-lapse." The uterus is also bent upon itself forward or "Ante-flexed." Abnormal increase in either the ante-version or ante-flexion is likely to cause pressure upon the bladder together with symptoms referred to that organ. Certain abnormal con-ditions may result in a tilting of the uterus, backwards into " Retro-version " or a bending into "Retro-flexion." Under these conditions, pressure upon the uterus from above will crowd that

organ into the pelvis, or if the muscle supports about the cervix are weak, will result in a definite falling of the uterus or " prolapse."

During menstruation and pregnancy the uterus undergoes characteristic changes which play an important part in the causation of pathological conditions. In response to stimuli received from the ovary arising in association with the expulsion of the matured ovum and development of the corpus luteum, definite changes take place in the uterus in an orderly manner. The mucous membrane and epithelium undergo marked hypertrophy, the submucous layer becomes thickened and much more vascular. The entire uterus together with its adjacent structures are congested and increase in size and weight. When the ovum remains unfertilized it passes into the uterus and is thrown off. The congestion of the submucous layers is relieved by the extrusion of blood between the epithelial cells resulting in the normal menstrual flow. It is commonly considered that the premenstrual engorgement and congestion of the uterus is in preparation for a future pregnancy, and that the woman menstruates because pregnancy has failed to take place. The mucosa and uterus return to normal within a few days and undergo periodic changes associated with ovulation. During the menstrual congestion there is an increased tendency to the development of abnormal conditions, infections and malpositions.

The **Vagina** is a membraneous canal extending from the external genital opening at the hymen between the rectum and bladder to a distance of about four inches. The cervix of the uterus projects into its upper and anterior wall, normally forming an angle acute with the vaginal canal. The upper portion of the vaginal canal surrounding the cervix is spoken of as the " Cul-de-sac," "Anterior, Posterior, or Lateral." The canal is lined with squamous protective epithelium, and contains no glands, but the normal secretions from the cervix together with the bacteria normally present have a protective influence against the more common bacterial invaders.

The External Genital Organs or Vulva (see Fig. No. 49) represent the opening of the genital tract to the surface. The " Labia Majora " are two folds united above at the symphyses pubis and below are continuous with the skin of the " Perineum,"

i.e., the area between the vulvar opening and the anus. These folds are covered with cutaneous epithelium, with pubic hair, and contain considerable fat, blood-vessels, and a special gland, " Bartholin's," which opens by a duct on the inner surface. This gland is important as being a common site for gonorrhoeal infection. As the"Labia Majora"are separated there are found two small folds, the " Labia Minora." These are covered with squamous epithelium and contain a special " Erectile " highly vascular tissue. They are continuous below with the posterior commisure of the opening and extended on each side to fuse above the uretheal opening of the bladder and cover the small " Clitoris " which is composed entirely of erectile tissue. The " Hymen " is a membraneous fold covered with squamous mucous membrane, extending across the vaginal opening back of the labia minora. There is normally a small opening sufficient to permit the escape of secretions or menstrual flow. There is considerable variation in the normal condition of the hymen. It is destroyed by injury, operation, or examination.

Surgical lesions of the tract may be studied under three headings: (1) Anomalies, Injuries, or Malpositions, (2) Infections, (3) New growths. (1) Congenital anomalies while comparatively rare, occasionally present most interesting surgical conditions. Only the most important ones can be mentioned. There may in extremely rare instances be a total absence of the internal organs, for which there is no surgical remedy. Less often there may be an absence of one ovary, in which case the corresponding tube is usually atrophic or wanting. During early fetal life the uterus, tubes and vagina develop from paired tubular canals, " Mullerian Ducts," the lower ends of which fuse to form the vagina and uterus. In some instances this fusion is incomplete. The most marked form of the anomaly is a double or " Septate Vagina " with two cervical canals and a double tubular uterus continuous on each side with corresponding Fallopian tube. More often the vaginal canal is normal or at most only partly septate with a single cervix and a divided uterus, the " Bicornuate Uterus." The two portions are usually unequally developed, and one cavity may have no opening into the cervical canal. Such a condition presents the possibility for abnormal development of pregnancy and serious complications. The lack

of fusion may be less marked resulting in a " Septate Uterus." A
few cases are described in which the vagina is atrophic or repre-
sented only by a short blind pocket. Somewhat complicated
surgical procedures have been developed to remedy this defect.
" Imperforate Hymen," a condition in which there is no opening
in the hymen at birth, is rare and as a rule causes no symptoms
till puberty. At this time sexual development takes place and the
sensations associated with menstruation occur at regular inter-
vals. Because of the imperforate condition of the hymen there
is no menstrual flow, the vagina and later the uterus and tubes
become distended with menstrual blood. There is commonly
severe pelvic pain due to the distention. The treatment is of
course surgical, a small opening to allow gradual escape of the
retained blood.

Injury to the genital organs may result from blows or falling,
and lacerations. In the normal non-pregnant condition these
organs are confined within the true pelvis and are therefore pro-
tected from external violence. Cystic fluid tumors of the ovaries,
or encapsulated abscesses which extend into the abdomen may
be ruptured by blows to the lower abdomen, resulting in hemor-
rhage or generalized infection. In such instances there is definite
indication for prompt surgical operation. Sudden jars or falling
may rarely result in the displacement of the uterus, especially
when the ligaments and supports are weak and relaxed, or when
the uterus is enlarged during early pregnancy, subinvolution, the
menstrual period, or when there are uterine tumors. Unless cor-
rected by proper treatment such displacement may become per-
manent and demand surgical measures. These acute displace-
ments usually are associated with definite local symptoms of pain.
Pedunculated tumors of the uterus or ovary may be displaced or
twisted upon their pedicle as the result of violence. This causes
severe congestion and pain which persists. Since the blood sup-
ply is contained in the pedicle, gangrene and suppuration of the
mass is likely to follow this complication. Surgical operation
is usually indicated as soon as the diagnosis is made.

Lacerations involve one of two areas, namely the cervix of
the uterus, and the vaginal outlet, and those of surgical interest
occur during childbirth. Lacerations of the cervix result from
the passage of the fetus through an incompletely dilated opening,

either spontaneously or by surgical delivery, *i.e.*, Forceps or Version, Minor lacerations are common but are not often repaired at the time of labor because the immediate effects are slight, and the operation requires a prolonged anæsthetic and presents increased danger of infection. Severe lacerations occur from rapid surgical delivery through a cervix which is only partly dilated. These may extend up into the body of the uterus, or into the broad ligament and be associated with severe hemorrhage. The fascia layers supporting the bladder and cervix are sometimes torn in such lacerations, resulting in displacement of those organs. The immediate effect of severe cervical lacerations is sharp continuous bleeding following delivery, which may demand prompt control by suture of the tear. The open wound in the cervix also presents an excellent portal of entry for infection and sepsis from a contaminated vagina.

Late effects of cervical lacerations include : (1) Eversion of the cervical canal in such manner as to expose the columnar uterine epithelium to the vaginal cavity, where it is subject to constant irritation. Such an exposed area forms a constant secretion and presents a characteristic appearance. It is often improperly spoken of as a "Cervical Erosion" or "Ulceration." (2) There is marked hypertrophy of the muscle and tissue of the cervical portion of the uterus. This adds to the weight of the cervix and is a factor in the causation of prolapse of the uterus. The mucous glands of the cervix increase in length and extend deeply into the tissues. Some of these tubular glands may become obstructed, giving rise to "Nabothian Cysts" of the cervix, which are simply obstructed and distended mucous glands. Such atypical tissue often becomes the seat of infection, especially gonorrheal, and may remain a focus of local reinfection indefinitely. Excessive scar tissue develops in the healing of unsutured lacerations and may be associated with atypical development of epithelium. In this respect such conditions are regarded as predisposing to cancer. Associated with lacerations of the cervix there may have been injury to the fascia supporting the uterus and bladder. This permits displacement downward of the cervix, and also of the bladder. There is bulging downward of the anterior wall of the vagina or "Cystocele" which furnishes a pouch in the floor of the bladder and makes possible the accumulation

of residual urine. In addition, the attachment of the bladder to the lower portion of the uterus is disturbed and the posterior wall of the bladder extends down nearly to the external os. Such conditions are usually associated with marked displacement of the uterus or prolapse. Clinical evidence of such lesions include : persistence of recurrent vaginal discharge, bladder symptoms ; irritability, frequency of micturition, or lack of control of the bladder. Examination by the surgeon gives definite and positive findings.

Treatment of late effects is entirely local. Applications to the cervix and the use of vaginal tampons, together with bladder irrigations may control troublesome symptoms temporarily. Such measures can not be considered as curative. For this purpose some operative procedure is indicated, commonly combined with other work to correct uterine displacement and treat other pathology. Operations on the cervix include : Rapid mechanical " Dilatation " to give access to the uterine cavity. This usually requires full anæsthesia and may be accomplished either by introducing graduated metal bougies increasing in size till dilatation is completed, or by metal dilators of the glove-stretcher type. *Curettage,* of the uterine cavity may be done for one of two purposes : (1) Diagnosis to secure for examination abnormal contents of the uterus, or endometrium. (2) Treatment, to remove such contents or pathological material from within the uterus. This procedure can be accomplished only after mechanical dilatation of the cervix and is done with some sort of a uterine curet. It may be followed by irrigations of saline or mild antiseptic solutions, local applications or packing with norrow antiseptic gauze. *Plastic operations* include : (1) **" Trachelorrhaphy,"** excision of scar tissue about lacerations and suture of the denuded area to reconstruct a proper cervical canal. (2) **Conical** excision of the cervical canal with the removal of " en bloc " of the gland bearing portion of the cervix. This is followed by a plastic reconstruction of the cervix in such a manner that the lower portion of the canal is lined by an infolding of the redundant vaginal mucosa covering the cervix. (3) **Amputation** of the hypertrophied cervix in one or two flaps and reconstruction of the stump. The procedures are commonly associated

with other operations on the vagina or within the abdomen to correct associated abnormal conditions.

Injuries to the vagina and vaginal canal occur most often as the result of childbirth, either spontaneous or instrumental. The upper portion of the vaginal canal about the cervix may be torn when the cervix is extensively lacerated as already described. This is sometimes associated with severe hemorrhage and requires immediate suture, while others heal spontaneously.   In either event there is likely to be considerable injury to the fascia supporting the cervix and bladder predisposing to displacements and prolapse of both of these structures.   All operations which have for their purpose the correction of prolapse and displacement of the uterus must include proper repair of injuries in this region.

Injuries to the lower portion of the vagina and outlet represent what are commonly called **"Lacerations of the Perineum."** These occur in a large percentage of women at the first confinement.   There are three grades of lacerations described.   FIRST DEGREE, which are comparatively superficial and involve only the mucosa and soft parts to a slight extent.   SECOND DEGREE, which involve the deeper Levator muscles which form the floor of the pelvis.   THIRD DEGREE, which tear through the sphincter muscle of the anus and into the mucosa of the rectum.   All of these are commonly repaired during the third stage of labor by the obstetrician and the immediate results are usually satisfactory.   In other instances there is injury to the deeper supporting structures with no superficial laceration, so that no immediate repair is indicated.   In such cases, especially when there are several confinements within a short time, serious injury to the soft parts forming the vaginal outlet result, even when there is no open laceration.   Under certain conditions the obstetrician makes an incision of the perineum in order to hasten delivery or to prevent deep laceration.   This procedure is called " Episiotomy " and may be either Median or Lateral.   Lacerations of the perineum including Episiotomy wounds are commonly repaired during the third stage of labor in order to close the wound and thereby avoid an open area of infection, and to repair the damage.   The first aim is usually attained, for such repairs almost always heal by first intent in spite of the fact that they are in a region easily contaminated, and aseptic care is difficult.   In

the case of third degree lacerations involving the sphincter of the anus, it is necessary to avoid bowel movements for several days, as ordered by the surgeon. The later results as regards absolute repair of the damage done are not always satisfactory. It is found, especially in women who have borne several children within a few years, that in spite of an apparently accurate immediate repair of lacerations, there is marked relaxation of the soft part. It is not always fair to criticize the care which such women have received at childbirth.

The effects of the deep second degree lacerations are a widening of the vaginal opening and a change in the direction of the canal from an oblique with the opening directed somewhat forward and upwards, to more nearly a perpendicular with the opening directed more nearly down. The posterior wall of the vagina is weakened and bulges forward, carrying with it the anterior wall of the rectum forming the " Rectocele " commonly observed. The effect of the change in direction of the vaginal canal together with the injury or separation of muscles and tissues of the perineum, favors displacement of the cervix downward and forward, predisposing to retroversion and prolapse of the uterus. Third degree lacerations unless repaired, result in an incontinence of the rectum and lack of control of the bowels. Under proper conditions immediate repair is successful, though occasionally a secondary operation will be necessary. In some cases the sphincter and lower part of the wound heal satisfactorily, while there is leakage through from the rectum into the vagina above, resulting in a " Recto-vaginal Fistula." Repair of such a condition demands a painstaking operative procedure and rigid aftercare.

In general the late effects of obstetrical injuries to the perineum and cervix vary from: (1) Relaxation of the vaginal opening with a Rectocele, (2) Laceration and hypertrophy of the cervix with eversion of the columnar epithelium, (3) Injury to supports of the bladder with downward displacement of the base of that structure forming a " Cystocele," to (4) displacement of the cervix downward and forward associated with " Prolapse and Retroversion" of the uterus.

Late operative repair of perineal lacerations or relaxations, " Perineorrhaphy " may be done as a separate operation or as is

most often the case combined with operations about the cervix, and procedures to correct malposition of the uterus.

Uterine Displacements include: (1) " Flexions " or bending of the canal, (2) " Versions " or tilting of the entire uterus, (3) " Prolapse," downward displacement. (1) Flexions may be either forward, " Ante-flexion " or posterior " Retro-flexion." (2) Versions may be either " Ante-version " or posterior " Retroversion." The normal position of the uterus is in moderate anteflexion and ante-version. Abnormal ante-version is quite rare and seldom is sufficient to demand treatment. This condition may be found associated with imperfect development of the uterus associated with dysmenorrhœa and sterility. In properly selected cases operative treatment will be advised. Posterior displacements are usually combined, *i.e.,* the uterus is retroverted and retroflexed. The condition is often associated with prolapse since the retroverted uterus is not as well supported by the pelvic structures. Posterior displacements may occur in young women and in those who have never been pregnant, as a result of one or more of the following causes: (1) Weak and relaxed ligaments and supports which permit of abnormal mobility of the uterus, (2) Occupations which require much standing or heavy lifting, especially when the uterus is congested at the menstrual period. (3) In comparatively rare instances, injury, falls, etc., may cause such displacement. (4) Tumors of the uterus or broad ligament. (5) Inflammatory disease of the Fallopian tubes may be a predisposing cause of displacement or may complicate such conditions, forming dense adhesions which fix the uterus in abnormal position, " Incarceration."

Effects: Posterior displacement of the uterus causes more or less interference with the normal blood supply of the uterus, Fallopian tubes and ovaries with congestion of these structures. The ligaments and supports of the uterus are further weakened and thereby rendered less efficient. The endometrium becomes abnormal in persistent cases, sometimes causing dysmenorrhœa or sterility. Symptoms pointing to the condition may be: pain and backache, often most marked at the menstrual period, or these may be entirely absent and the malposition will be discovered only at routine examination. Indications for treatment may be: to relieve symptoms or to correct an abnormal condition

in order to avoid later effects. It is only fair to say, however, that many symptoms are charged to retrodisplacements of the uterus which are in reality due to other causes, and these are not relieved by simple correction of uterus. Treatment will consist of either manual replacement of the uterus in normal position possibly under anæsthesia, and artificial support, for a period with suitable pessary, or surgical operation. The latter method will be undertaken only for selected cases after considerable study. A great number of operations have been described for this purpose, but at the present time it is customary to make an abdominal exploration, remove the appendix, correct any associated pathological condition which may be present, and suspend the uterus by some technique of shortening the round ligaments, or in some cases shortening the broad ligaments or the uterosacral ligaments as well.

In women who have borne children there are several factors which cause retrodisplacements: (1) Injuries to the pelvic floor or to the supports about the cervix. (2) Subinvolution, *i.e.*, failure of the uterus to promptly return to normal size after pregnancy, resulting in backward displacement of the heavy congested organ. (3) Infection extending to the tissues about the uterus, with adhesions. In these conditions there is commonly considerable prolapse of the uterus and adjacent organs. The symptoms are those of the displacement together with those of prolapse, and the associated conditions. There may be backache, pelvic pain and distress, bladder disturbances, frequency or incontinence of urine. Menorrhagia is often a marked symptom due to secondary changes in the uterus.

Treatment: For the early cases without marked prolapse; manual correction, together with the " Knee-chest position " at night and a suitable pessary will often correct the condition permanently. However, for long-standing cases or those with marked prolapse, the use of a pessary is simply palliative and does not tend to cure the condition. In cases where the malposition and prolapse is marked, an effective operation for its correction is usually indicated sooner or later. Since there are a number of possible associated conditions present, the operative procedure will be selected to suit the individual case. In a general way these patients will be divided into two groups: (1) Those

who are still within the childbearing age and in whom the pos-
sibility of future pregnancy must be considered. (2) Those
who are approaching, or past the menopause. It is usually
preferable to delay operation till the patient has passed into the
second group, but in many instances the discomfort is such that
delay is not justifiable. In these cases it is important that
nothing be done which will interfere with the mobility of the
uterus or, with its changes during subsequent pregnancy and
puerperium. The operative work in these cases will include the
necessary repairs to the cervix, vagina, and perineal floor, com-
bined with abdominal incision to treat any associated pathological
conditions and correct the position of the uterus by some method
of folding one or more pairs of the uterine ligaments. For
women who are approaching or past the menopause, it is possible
to do a more radical fixation of the uterus or in suitable instances
to remove a portion of the uterus and securely suspend the re-
maining cervical stump. In certain selected cases it is possible
to perform the entire operation through the vagina. Such an
operation will consist of the following steps: Plastic operation
on the cervix, opening the anterior vaginal wall and thorough
separation of the bladder from the uterus, the peritoneal cavity
is then opened and the fundus of the uterus is sutured forward
under the bladder, the anterior vaginal wall is then closed and
proper perineal repair is made. This is the so-called " Inter-
position operation." In other cases a part of, or the entire uterus
is removed and the stump is fixed high up under the bladder,
followed by the perineal repair. The more common procedure
is to begin with the cervical plastic operation together with the
perineal repair and then, through an abdominal incision to
properly treat such associated pathological condition as may be
present and to suspend the uterus by fixing it to the abdominal
walls or by shortening and folding of the ligaments. In some
instances a sub-total or total hysterectomy is done and the stump
is securely suspended in an appropriate manner.

Infections involving the generative tract are commonly
studied under three headings: (1) Those complicating pregnancy
or labor. (2) Venereal usually Gonorrhoeal, (3) Tuberculosis.
(1) During pregnancy, original infections of the tract, aside
from venereal, are exceedingly rare, though a latent process may

become active and cause a violent reaction. This type of infection usually develops as a complication following abortion or labor. Excellent portals of entry are presented: (1) The entire endometrium but especially the site of placental attachment. (2) Lacerations of the cervix, vaginal canal or outlet. The casual organisms may be present in the vaginal canal previous to labor, and the process develops without any external contamination. Most often, however, the infectious organisms are introduced at the time of labor or abortion by the obstetrician's hands or instruments, or during the puerperial period. The organisms usually causing these infections are: some variety of staphylococcus or streptococcus and less often the colon or one of the gas forming organisms. The primary process is essentially an obstetrical problem, and surgical treatment is rarely undertaken during this period. The infection primarily involves the edometrium and extends through the lymphatics into the musculature of the uterus and tubes. Further extension may take place into the surrounding supporting tissues causing a " Parametritis " and forming a large mass of inflammatory tissue which may result in an abscess cavity, or the infection is carried by the lymph vessels into the pelvic peritoneum causing a pelvic and later general peritonitis of a highly virulent type. During the acute stage general supporting therapeutic measures are used, but local treatment is withheld except to drain a localized abscess, or peritonitis. In a few carefully selected cases attempts have been made to remove the entire focus of infection by early hysterectomy, but the results have not been encouraging.

The late effects of this type of infection include: (1) An encapsulated abscess which may contain organisms of low virulence, but still capable of causing severe recurrence under proper conditions. (2) Adhesions between the uterus, tubes or ovary and surrounding peritoneum binding the structures together. (3) Changes in the uterus and tubes are limited largely to thickening and sometimes a degeneration of the musculature of these structures. SURGICAL TREATMENT of these conditions is usually undertaken at a period remote from the active stage and may have for its object: (1) The excision of the encapsulated suppurative processes. (2) Removal of structures, tubes, ovaries, or uterus, which are permanently damaged. (3) Separation of

adhesions and correction of displacements of pelvic organs which may be associated with or dependant upon these inflammatory processes.

Gonorrhoea is the only type of venereal infection which presents serious surgical lesions. The original focus is usually at the vulva in the region of the urethera, and the process later extends to the cervix and to the Fallopian tubes. Surgical treatment is rarely indicated for any of the acute processes. The infection has a marked tendency to become chronic in one or more of the following locations. (1) The small Para-urethral or " Skene's glands " where the organisms may persist for a long time. It is sometimes necessary to lay these areas open and to cauterize the small cavities to clear the infection. (2) The Vulvo-vaginal " Bartholin's " glands located in the labia majora are often involved in an acute inflammatory process which may go on to suppuration. Secondary to this there may be involvement of the inguinal lymph-nodes in the groin, and these may break down. Suppuration in the Bartholin's gland will require active treatment; preferably enucleation of the broken down gland tissue, and obliteration of the cavity, although in some cases the less satisfactory method of incision and drainage may be all that is possible. Prompt and efficient treatment of the primary focus usually limits the process in the inguinal lymph-nodes, but in cases where these break down and suppurate, incision and drainage will be indicated. (3) The Cervix of the uterus is usually involved early in gonorrhoeal infection, and there is a marked tendency for the process to become chronic in this region through extension along the columnar glands of the cervical edomatrium. Here the condition may resist active treatment and remain as a persistent focus for reinfections. In some properly selected cases radical treatment by the cautery or by plastic operations may be indicted to remove such foci. (4) In the Fallopian tubes the process involves principally the mucous and submucous layers. The fimbriated ends of the tubes become adherent and tend to seal off the tubes so that these are distended with purulent contents forming the " Pus-tubes " found at operation. In some cases an abscess developes in the pelvic peritoneal cavity involving the broad ligament and ovary, the " Tubo-ovarian abscess." The process sometimes extends secondarily filling the entire

pelvic cavity with an inflammatory mass containing numerous abscesses. In rare instances there may be a rapid extension and development of a general peritonitis. In these cases of acute gonorrhoeal salpingitis there is fever and other evidence of an inflammatory reaction together with pelvic pain, tenderness and distress. The condition usually improves after one or two weeks of rest, application of ice bag to the lower abdomen and suitable expectant treatment. Surgical measures are not commonly undertaken during an acute attack and are preferably reserved for the chronic or recurrent cases. There is a marked tendency for the infection to recur and to become a cause of persistent pelvic distress of some type. In this event the organs involved, with the possible exception of the ovary are destroyed as far as useful function is concerned and remain only as dangerous foci of infection. Surgical treatment is preferably undertaken at a period remote from an acute attack, but this is not always possible. Surgical treatment will include the removal of the organs involved; always one or both tubes, sometimes the ovaries, and in severe cases, of partial hysterectomy including the tubes and ovaries. In cases where suppurating cavities are opened drainage may be provided either through the abdominal wound or vaginal incision.

Tuberculosis of the genital organs is found most often in the cervix or Fallopian tubes. The process is chronic and is usually secondary to foci in other portions of the body. The diagnosis is often made only on microscopic study of material removed, but in many instances the clinical picture is definite. Tuberculosis salpingitis may represent the cause of this form of peritonitis, which condition is likely to persist till the focus in the tube is removed. Treatment is surgical removal of the organs involved, followed by proper constitutional measures.

Tumors or new growths are most commonly found in the uterus or ovaries, but may involve any portion of the tract. In the region of the Vulva one may find the various types of benign or malignant skin tumors arising from the squamous epithelium. The malignant cancers of this region are often extremely active, grow rapidly involving the inguinal and deep lymph-nodes, and tend to recur even after extensive removal. In the region of the labia majora deep-seated growths may develop from the sub-

cutaneous tissues, Fibromata or Lipomata. Cystic tumors of Bartholin's glands develop from obstruction of the duct and retention of contents. This condition is usually the result of gonorrhoeal inflammation and not properly a new growth. Tumors arising from the walls of the vagina are quite rare, but certain types of cystic masses may develop in the wall and project into the vaginal canal. These tumors are commonly thought to develop from congenital abnormalities but may not become evident till middle life or during pregnancy. These cysts are usually removed through the vagina and without serious risk.

Tumors of the **Uterus** arise from either the muscular and fibrous wall or from the epithelial layer. In the first instance we may find the benign connective tissue growth the "Fibromyoma" also commonly called "Myoma" or by others called "Fibroid." These growths contain both fibrous and plain muscle tissue so the proper term is "Fibro-myoma." They arise in the muscular wall of the uterus and may be either single or more often multiple. They vary in size from one to six or eight inches in diameter. Fibroids are most commonly found in the fundus of the uterus but less often they may originate in the cervical portion and extend into the vagina or into the broad ligament. They may be located in the wall of the uterus as "Mural" tumors, may project into the peritoneal cavity being covered only by the peritoneum as "Subserous" tumors and later become attached to the uterus by a narrow pedicle as "Pedunculated" masses, or extend into the uterine cavity as "Submucous" growths. In some cases these become pedunculated as Uterine Polyps which may protrude through the uterine canal. Though this type of tumor is often multiple, each is definitely encapsulated and benign. There is no Recurrence after removal of all of the tumors present or of the entire uterus. Certain forms of "Degeneration" may take place: (a) Calcification where the blood supply is being gradually cut off; (b) Fatty degeneration and necrosis from pressure or interference with blood supply; (c) Malignant degeneration to some type of sarcoma occurs in a few instances from causes which at present are not clearly understood.

Fibroid tumors may be present for months or years and cause no definite symptoms and these effects may develop gradually or make their appearance suddenly following a period of rapid

growth or change in the tumor. Pain or pressure in the pelvis
and symptoms referred to the bladder or rectum occur from the
mechanical effects of such growths. Pain may be referred to the
limbs, from pressure on the nerve trunks in the pelvic wall.
Pedunculated tumors are liable to become twisted upon the
pedicle causing acute persistent pain and later degeneration or
necrosis of the mass. Submucous fibroids or polyps are com-
monly associated with profuse and prolonged menstrual bleeding.
Rapid increase in size of the mass is an indication of some type
of degeneration, and may be associated with toxic effects from
increased absorption of necrotic material. **Treatment** is com-
monly advised for all such tumors which are causing symptoms
or which show evidence of growth or change in character. Surgi-
cal operative treatment will consist of one of two types of opera-
tion : (1) " Myomectomy " removal of one or more tumors and
plastic repair of the uterine wall. This is suitable for single
growths, for those which are pedunculated, or when there are but
a few tumors which can be enucleated leaving the uterus in good
condition, free from any remaining growths. This operation is
commonly preferred for women who are still within the child-
bearing period, even though there is a possibility that one or
more small tumors have been left and that these may later de-
velop to necessitate secondary operation. (2) In cases where
there are a large number of growths scattered through the organ,
or where it is not necessary to preserve the uterus, the operation
of " Hysteromyomectomy " is selected. In a few carefully
chosen cases, Radium is used successfully in the treatment of
these growths.

Malignant Tumors of the uterus include : (1) Sarcoma of
connective tissue or muscular origin. Some of these may develop
from degeneration of pre-existing fibroids, while others occur
primarily as sarcomata. The causes are unknown. Symptoms
are those of pressure together with a rapidly growing tumor.
Treatment, is removal by hysterectomy as soon as the possibility
of a sarcoma is suspected. Recurrence is not uncommon.

(2) **Cancer** of the uterus develops from the epithelium lining
the uterus, either the body or cervical portion, or from the
squamous epithelium of the vaginal part of the cervix. From a
surgical standpoint the subject is considered in two groups :

(a) Cancer of the body of the uterus arises from the cylindrical epithelium of the endometrium and is of the glandular type. Development is slow and extensive metastases occur relatively late in the course of the process. The prognosis following hysterectomy is good and recurrence is uncommon. There is destruction of endometrium with a tendency to excessive and irregular bleeding. The characteristic symptom is the appearance of "Metorrahagia" which may or may not be accompanied by excessive menstrual flow. The condition is more common in women over forty, but must be suspected in any woman over thirty. The history of irregular uterine bleeding unless definitely associated with pathological condition of pregnancy or the puerperium gives suspicion of cancer and must always be explained. Examination under an anæsthetic at times followed by a diagnostic curettage, will be necessary. In doubtful cases exploration of the uterine cavity and microscopic study of the material removed by the curettage will usually make the diagnosis. Occasionally other conditions: portions of retained placenta or membranes from a remote pregnancy, or pedunculated uterine polyps will be found and the symptoms be relieved. In case of negative findings from the curettage, with persistence of the bleeding, complete hysterectomy is often properly performed and a small area of cancer demonstrated which was not discovered by the curette. Treatment is always surgical, i.e., complete hysterectomy with removal of the cervical portion. This type of operation carries with it a low mortality and gives such satisfactory results that it is commonly recognized as the treatment of choice. It should be done as soon as the diagnosis is made or suspected, provided other definite cause for the bleeding cannot be demonstrated. Radium is claimed to give excellent results for this type of cancer but not superior to those from hysterectomy, so it is commonly reserved for patients in whom operation is contra-indicated. (b) Cancer of the **Cervix** may be either: glandular "Adeno-carcinoma" from the cylindrical epithelium of the cervical canal, or "Squamous" from the vaginal portion of the cervix. In either type growth is rapid, destruction of tissue occurs early, and extensive involvement of the surrounding structures takes place with metastases to the lymph-nodes in the pelvis and lower abdomen. This form of cancer is rapid in its growth, early becomes so

extensive as to be inoperable because of involvement of other organs or structures, and recurrences are frequent. It is important that the early symptoms be kept in mind and suitable information be brought to all women over thirty years of age. Symptoms include: (i) Irregular bleeding. This may be simply small amounts, only spotting the clothing, watery or purulent discharge tinged at times with blood, or profuse bleeding at irregular times other than the menstrural periods. It is important to remember that the normal woman menstruates at remarkedly regular intervals throughout life. That the duration of flowing may vary somewhat, but that always, there is a free period of about three weeks. Bleeding to any extent which occurs during this free interval must be explained by exhaustive examination if necessary. This is particularly true at the menopause at which period women seem to expect almost any irregularity. (ii) Vaginal discharge is usually present and is different from the ordinary leucorrhoea in that it may be; watery, blood-tinged, or foul-smelling. These two are the only early symptoms of cancer, and the appearance of either demands a diagnosis and treatment without delay. Diagnosis is usually a simple matter by proper examination or in a few instances by microscopic study of tissue removed. If all cases of cancer of the cervix could be brought to treatment at this stage, results would be improved by at least 100 per cent. Unfortunately this result has not yet been attained, but it is to be hoped that by education of the professions of nursing and medicine, and through these, of the public, that more of these women will come to treatment at a favorable stage of the disease. (iii) Pain in the pelvis and referred to the bladder or rectum is a relatively late symptom and is due to extension of the growth to surrounding structures. In some instances extension of the disease is so rapid that by the time the patient comes to treatment there is already evidence of involvement of the bladder or rectum with possibly an impending fistula either " Vesico-vaginal " or " Recto-vaginal." In others there may be evidence of metastases in remote parts of the body. From a surgical standpoint the cases are considered as (i) Operable, *i.e.,* the growth is confined to the cervix and uterus so that the entire area can be safely excised surgically. (ii) Doubtful, *i.e.,* evidence of extension in the broad ligament or surrounding tissues so that the true condition can be determined only at

exploratory operation. (iii) Inoperable with definite evidence of wide-spread involvement.

Treatment is indicated as soon as the diagnosis is made or definitely suspected. Surgical treatment consists of an extensive removal of the entire uterus, tubes and ovaries with portion of the vagina. This sometimes involves an extensive dissection of the pelvic structures in an attempt to remove the lymphatics, similar to the radical operation for cancer of the breast. However this procedure carries a high primary mortality and has been abandoned by many surgeons. In really early cases the " Panhysterectomy " with a wide border of vagina offers a reasonable prospect for cure with a risk which is not excessive, and is commonly advised. For the other cases non-operative treatment is indicated. At present **Radium** is the agent commonly used. At first it was applied only to the late or inoperable cases to relieve distressing symptoms. However, the curative results even in these hopeless conditions were so promising that radium is advised by many conservative surgeons in treatment of early cases. In this connection only a few suggestions can be offered. This treatment presents many technical points and should be used only under proper conditions. It presents many possibilities for danger and untoward results, and should be administered only by thoroughly experienced physicians.

New growths of the **Fallopian tubes** are quite rare and are limited practically to cancer arising from the epithelial layer. In the Broad Ligaments one may occasionally find fibroid tumors growing from the uterus and sometimes reaching considerable size. Pressure effects may be present and symptoms will depend upon these. The diagnosis after examination will usually be that of a pelvic tumor which is fixed but cannot be differentiated from a uterine or ovarian mass. Surgical removal is often complicated by distortion of normal structures by growth of the tumor. Cystic masses may develop in the broad ligaments from certain embryonic structures or those associated with the ovary. They present the same difficulties of diagnosis and removal as do the broad ligament fibroids.

Tumors of the **Ovary** are common and occur at almost any age. The Benign growths are usually, some form of a cystic mass developing in an abnormality of the Graafian Follicle or Corpus Luteum. These masses may consist of a single cavity

but quite often are of the "Multilocular" type, *i.e.*, contain several spaces. The size varies from one, to eight or ten inches in diameter and the mass may develop with great rapidity. One or both ovaries may be involved. Most of the cysts contain sterile material of a serous or mucous type, though infection does occur in certain types of tumors. Symptoms include some variations in menstruation though these are not constant or characteristic. The most frequent symptoms are pains from pressure or torsion of the tumor, and these are likely to be increased at the menstrual period. Large cysts often cause pressure on the nerve trunks in the pelvis with pains referred to one or both limbs. Sudden torsion of a cystic ovary will cause severe constant pain suggesting acute abdominal condition. Physical examination demonstrates a cystic mass, which however, may give the impression of a solid, usually movable, extending from the pelvis and in some cases filling the abdomen. It is not always possible to distinguish these tumors absolutely from those of the uterus.

Treatment is surgical, removal as soon as the presence of an ovarian cyst is made. In many cases it will be necessary to remove the entire ovary, but in some it will be possible to enucleate the cystic portion and leave sufficient ovarian tissue to preserve the internal secretion. This is most important when both ovaries are involved in young women. Solid benign Fibroid tumors of the ovary are relatively uncommon and are usually of small size. The diagnosis is made on gynecological examination and the treatment is surgical removal. **Malignant Tumors** of the ovary include: (1) Sarcoma which is relatively rare and seen most often in young girls, or women near or past the menopause. This type of growth develops rapidly and cause marked pressure symptoms. The diagnosis is suggested by the age and rapidly growing tumor. Treatment is surgical removal as soon as the diagnosis is made, but recurrence is frequent. (2) **Cancer** of the ovary occurs in certain types of cystic tumors in women during the latter part of menstrual life. It may develop in a cyst which has been present for a long period or in women with no evidence of pre-existing conditions. Growth is rapid and both ovaries may be involved. The diagnosis is suggested by the presence of a rapidly growing mass in the ovary or evidence of reaction in the peritoneal cavity, Ascites. Removal is com-

monly advised but many of the cases are inoperable when they come for treatment, and recurrence is not uncommon.

DEMONSTRATIONS

1. Anatomy from charts or figures.
2. Lantern slides showing microscopical structure of uterus, fallopian tubes, ovaries, etc.
3. Clinical demonstration of lacerated and hypertrophied cervix and perineal relaxation.
4. Care and preservation of curettage specimens.
5. Types of Pessary, methods of care and sterilization.
6. Various positions for gynecological examination or treatment.
7. Methods of taking vaginal or uterine smears or cultures.
8. Methods of preparing and giving vaginal douche.
9. Anatomical specimens and slides illustrating various types of new growth.
10. Special gynecological instruments, mechanism and care.

GLOSSARY

A

Abdomen. (See Anatomy.) That portion of the body between the thorax and pelvis, limited above by the diaphragm and below by the brim of the pelvic bones. *Regions:* hypochondriac, epigastric, lumbar, umbilical, iliac and hypogastric. Divided by transverse lines through (1) the tenth ribs, and (2) the crest of the iliac bones; and perpendicular lines through the nipple or the middle of the clavicles. *Walls* (see p. 159 and Anatomy.)

Abduction. To move a part or limb from the mid-line or axis of the body.

Abortion. 1. The expulsion of the impregnated ovum before it is viable, *i.e.,* before the first six months. 2. The premature cessation of a pathological or natural process.

Abscess. (See p. 10.) A localized collection of pus.

Acid. (See Chemistry and Pharmacology.) A sour substance which turns blue litmus red, combines with alkalis to form neutral salts.

    A. Boric, or **Boracic,** H_3BO_3, white crystals, mildly antiseptic, used in saturated, 3% solution, or ointment in about the same strength.

    A. Carbolic, phenol, C_6H_5OH, crystals, fluid in 95% used as caustic (pure carbolic), a corrosive poison, antiseptic, and analgesic, used in 2% sol. as irrigation.

    A. Mineral. include nitric, hydrochloric, and sulphuric.

    A. Organic. (See Chemistry.) Hydrogen compounds containing carbon and oxygen.

Acne. A chronic skin disease involving the sebaceous glands particularly of the face and back.

Acquired. Not inherited, occurring after birth.

Actinomyces. (See p. 37 and special works.) A vegetable parasite of cattle, rarely seen in man.

Acute. Sharp, of relatively short duration or extent as compared to chronic. Characterized by rapid onset and increase to a climax and recovery or fatal termination.

Addison's disease. (See Text-book on Medicine.) A wasting disease characterized by pigmentation of the skin, low blood pressure. Fatal: due to tuberculous destruction of the adrenal bodies.

Adduction. A movement by which a part or limb is drawn toward the mid-line.

Adenoma. An epithelial tumor resembling in microscopic structure that of a secreting gland.

Adenoid. Resembling a gland. Adenoids, masses of lymph tissue found in the naso-pharynx. (See p. 138.)

Adhesion. An abnormal union between two surfaces, usually due to inflammatory destruction of the superficial cells, especially of peritoneum.

Adolescence. Youth, the period between puberty and maturity.

Adrenal. (See Anatomy and Physiology.) An organ having an important internal secretion influencing body metabolism. Located above the kidney.

Adrenalin, also EPINEPHRIN. (See Pharmacology.) An extract of the active principle of the adrenal gland supplied in solution of 1 to 1000.

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Aërobic. Requiring oxygen. (See p. 2.)

Afferent. Carrying towards a centre (nerve centre). Centripetal.

Agar-agar. A gelatinous-like substance which is fluid only at a temperature higher than that of the body. Used as a culture medium in bacteriology, and in the treatment for certain types of constipation.

Air-hunger. A type of breathing due to an insufficient supply of oxygen reaching the tissues.

Alimentary tract. (See Anatomy and Physiology.) The digestive organs extending from the mouth to the anus.

Alkali. (See Chemistry.) Turns red litmus blue; combines with acids to form neutral salts.

Alveolar process. Pertaining to the jaw-bone about the roots of the teeth.

Amenorrhœa. Cessation of the menstrual periods.

Ambulant treatment. That which allows the patient to be up and about.

Amœbic. A pathological process caused by the Amœba Coli. (See special works.)

Ampulla. (See Anatomy.) A dilated extremity of a canal or passage.

Amputation. Cutting away or complete removal by the knife, also by sloughing or gangrene.

Anaërobic. (See Bacteriology and Micro-organisms, p. 2.) Living best in the absence of oxygen.

Analgesia. Insensibility to or absence of pain.

Anaphylaxis. (See Bacteriology and Immunity.) A reaction in the body caused by the injection of a foreign serum or proteid.

Anastomosis. 1. A communication between blood-vessels. 2. The formation of an artificial opening between two hollow cavities or passages.

Anatomical. Pertaining to structure.

Anemia. Deficiency of the blood as a whole or of one of its elements. Characterized by a decrease in the number of red blood-cells, or of the per cent. of hæmoglobin, or both. **Local A.** due to obstruction of the blood-supply to a part.

Anæsthesia. Lack of sensation. **Surgical A.** (See p. 67.) Induced by drugs (anæsthetics), causes loss of consciousness to external painful stimuli, and relaxation of the voluntary muscles.

Aneurism. (See p. 93.) A localized or circumscribed dilatation of an artery.

Angioma. A tumor formed of blood-vessels, capillaries.

Ankle. The joint between the leg and the foot.

Anomaly. A marked deviation from the normal structure or function.

Anorexia. Absence of appetite, distaste for food.

Anterior. Situated in front of, pertaining to the part of an organ or structure situated in the ventral or front part of the body.

Anthrax. (See special works.) A disease of horses and sheep, extremely fatal in man.

Antiseptic. An agent which prevents the growth of bacteria.

Antitoxine. (See Bacteriology.) A substance which destroys or neutralizes particular toxines, usually the serum of a horse or an animal which has been immunized to the specific infection in question. Diphtheria.

Antrum. (See Anatomy and p. 131.) A cavity or space, usually in bone, particularly those spaces communicating with the nasal passages.

Anuria. A suppression of urine, due to lack of secretion.

Anus. (See Anatomy.) The external opening of the lower bowel, from the rectum.

Aperient. A mild laxative or cathartic.

Aphasia. Partial or complete loss of the power of expressing ideas by means of speech or writing, due to lesions of the brain centres.

Aponeurosis. (See Anatomy.) A fibrous membranous expansion of a muscle tendon, giving attachment over a broad area, or forming a fibrous sheath.

Apoplexy. Usually refers to the condition resulting from spontaneous hemorrhage into the skull or substance of the brain. (See p. 108.) Also refers to any spontaneous hemorrhage into the tissues of any solid organ.

Appendicitis. (See p. 191.) An inflammation involving the vermiform appendix.

Apposition. The accurate fitting together of divided parts.

Arachnoid membrane. (See Anatomy.) A delicate membrane covering the brain and spinal cord, located between the dura and pia mater.

Areola. The pigmented brownish area surrounding the nipple of the breast.

Argyol. (See Pharmacy.) A proprietary preparation of silver, said to be non-irritating even in strong solution, 10% to 25%.

Aristol. A proprietary antiseptic dusting powder.

Arm. The upper extremity from the shoulder to the wrist, sometimes limited to the elbow. Forearm, from the elbow to the wrist.

Arterio-sclerosis. (See Medicine.) A pathological condition characterized by degeneration, thickening, and weakening of the arteries.

Arterio-venous. Involving both artery and vein. *Example:* certain aneurisms.

Articulation. (See Anatomy and p. 89.) A union of bony surfaces which permits of motion.

Ascites. (See p. 167.) An abnormal collection of clear serous fluid in the peritoneal cavity.

Aseptic. (See p. 4.) Free from bacteria or micro-organisms.

Asphyxia. The suspension of vital phenomena resulting when the lungs are deprived of oxygen.

Aspiration. A method of withdrawing fluids or gas from a cavity with special apparatus.

Aspirator. Consisting of a hollow needle or "trocar" and a suction apparatus or syringe.

Asthma. (See Medicine.) A spasmodic or paroxysmal affection of the bronchi characterized by dyspnœa, cough and suffocation, due to local or constitutional causes.

Ataxia. An incoördination of muscular activity; may be general or involve only special groups.
Locomotor A. Also "Tabes Dorsalis." (See Medicine.)

Atmospheric pressure or tension. (See Physiology and Physics.) The pressure exerted by the air on the surface of the body, normally at the sea level is 15 pounds to the square inch.

Atony. Loss of power, particularly muscular.

Atrophy. Diminution in size of an organ or tissue, as a result of degeneration of the cells or lack of use.

Atropine. (See Pharmacy.) An alkaloid, often used in combination with morphine, hypodermically in doses of gr. $\frac{1}{150}$ to $\frac{1}{120}$. Used by ophthalmologists to secure dilatation of the pupil.

Atypical. Irregular; varying from the regular type of structure or function.

Autogenous. A condition produced from within the body; not derived from external sources. Autogenous vaccine, one produced from cultures made from the particular infectious process.

Auto-intoxication. Poisoning caused by substances derived from faulty body metabolism, and not from external causes.

Autopsy. A post-mortem examination of the body and its organs after death.

Axilla. (See Anatomy.) The arm-pit.

Axis-cylinder. (See Anatomy and p. 98.) That process of a nerve-cell "neurone" through which nervous stimuli are transmitted

B

Bacillus, plural *bacilli*. (See Bacteriology and p. 1.) The rod-shaped bacteria.

Bacterium, plural *bacteria*. (See Bacteriology and p. 1.) A form of micro-organisms.

Barium sulphate. Used with buttermilk or potato in connection with X-ray and fluoroscopic picture of the gastro-intestinal tract.

Bartholin's duct. That of the sublingual gland. **Barth gland.** That located in the vulva, often involved in gonorrheal inflammation.

Basedow's disease. (See p. 145.) Exophthalmic goiter.

Basement membrane. (See Anatomy and p. 5.) A definite membrane underlying mucous epithelium.

Bedsore. An ulceration or necrosis, produced by trauma or continued pressure on parts in which there is interference to the blood or nerve supply.

Belladonna. (See Pharmacy.) Used in lotions or ointments for local soothing effects, also given internally.

Belly. Refers to the abdomen.

Benign. (See Tumors, p. 42.) Not dangerous to life.

Benzene (C_6H_6). (See Pharmacy.) A colorless hydrocarbon fluid used for cleansing the skin preliminary to surgical operation.

Benzoates. (See Pharmacy.) Salts of benzoic acid used in medicine as a urinary antiseptic.

Bichloride. A salt containing two chlorine equivalents; often refers to mercury-bichloride, CORROSIVE SUBLIMATE.

Bifurcation. The division of a structure into two equal branches.

Bile. (See Physiology.) The secretion of the liver. It contains chiefly 1. B.-pigments, bilirubin and biliverdin, derived from broken-down blood-cells.

2. **B.-salts,** sodium glycocholate and taurocholate. 3. "Cholestrin" and mucus from the gall-bladder.

Bile-ducts. (See Anatomy and p. 200.)

Biliary. Referring to the bile apparatus and ducts.

Birth. The delivery of a child, "parturition."

B.-canal, the passage in the mother through which the child is delivered.

B.-mark, pigmented or vascular tumors present at birth.

B.-palsy, a paralysis due to injury to the nervous system from accidents in delivery.

Bismuth meal. Preparation of salts of bismuth with milk or potato used in X-ray and fluoroscopic pictures of the gastro-intestinal tract.

B. paste, also "Beck's paste," bismuth subnitrate in two parts of vaseline, or with addition of wax or paraffin to give a higher melting point. Used in chronic sinuses or abscess cavities.

Bladder. A membranous sac for the reception of fluids. Example: gall-bladder. If not qualified, refers to the urinary bladder.

Blastomyces. (See special works and p. 37.) A yeast-like organism infecting the skin and mucous membranes.

Blood. (See Physiology.) **B.-clot,** coagulated blood.

B. cultures. (See p. 14.) Bacteriological cultures made from blood aspirated from the veins under aseptic conditions.

B. infections, those in which the organisms have invaded the general circulation.

B. letting or **bleeding,** the withdrawal of blood from a vein as a therapeutic measure.

B. parasite, a form of micro-organism which attacks the formed elements of the blood. Example: malaria. (See Medicine.)

B. poisoning. (See p. 13.) The extension of a local infection characterized by the invasion of the blood-stream by bacteria and their toxines.

B. transfusion. (See p. 94.) The operation of transferring blood from one individual, the "donor," to another, the "recipient." *Direct* transfusion, by bringing the open artery of the donor into actual contact with an open vein of the person receiving the blood, allowing the blood to flow directly from one to the other. *Indirect transfusion,* when the blood is withdrawn from the vein of the donor with a syringe and injected into the vein of the recipient.

Bone, bone-marrow. (See Anatomy and p. 72.)

Boil. A localized inflammation in the skin and subcutaneous tissue.

Bougie. A slender flexible cylindrical instrument used to explore or dilate a narrow passage (urethra or œsophagus); made of rubber composition and can not be boiled.

Brachial. Pertaining to the upper extremity.

Bradycardia. Slowness of the heart beat, usually under 50 per minute

Brain. (See Anatomy.) The portion of the central nervous system contained within the skull; includes: the cerebrum, cerebellum, pons varolii, and medulla oblongata, together with the four ventricles.

Breast. (See p. 156.) The mammary gland.

Broken compensation. (See Medicine.) A pathological condition occurring when the heart is unable to maintain a normal equilibrium of the circulating blood, resulting in a venous congestion of the tissues.

Bronchitis. (See Medicine.) An inflammation involving the mucous lining on the bronchi.

Broncho-pneumonia. A similar inflammation which also involves irregular portions of the lung.

Bubo. Inflammation and swelling of a lymph-node, particularly in the groin.

Bunion. A painful swelling usually involving the bursa of the great toe.

Bursa. (See Anatomy and p. 91.) A membranous sac, interposed between muscle tendons or between a ligament and a bony surface. The sac contains a synovial fluid and prevents friction.

Button, Murphy's. A metal device originated by Dr. J. B. Murphy used in making an anastomosis between portions of the gastrointestinal tract. **Button** also refers to the circular bit of bone removed from the skull by a trephine.

C

Calcification. The deposition of calcium salts in certain tissues.

Calcium. (See Chemistry and Physiology.) Lime-salts, important in the structure of bone and in certain concretions.

Calculus, plural *calculi*. Stone-like formations found in the body, particularly in certain cavities.

    Biliary C. (see p. 203), composed of bile-salts, and found in the bile-passages.

    Fecal C., formed of hardened material lodged in the intestinal tract, particularly the appendix.

    Urinary C. (see p. 212), those formed in the urinary tract.

Callus. (See p. 88.) The new bone formation about a fracture. Also a "corn" or a local area of hard skin composed of modified epithelium.

Camphor. (See Pharmacy.)

    Camphorated oil, used in sterile solution hypodermically as a stimulant; dose 5-15 min.

Canal. Any tubular passage or channel. Example: alimentary, femoral, inguinal.

Cancellous. Structure resembling lattice work, especially bony.

Cancer. (See p. 46.) A malignant tumor of epithelial origin.

Cancrum oris. Ulceration, often gangrenous, of the mucous membrane of the mouth.

Canker. (See Medicine.) A vesicular ulceration of the mouth.

Capillary. (See Anatomy and p. 54.) Tubes of minute size, hair-like.

Capsule. A sheath, usually composed of fibrous tissue, surrounding certain organs or benign new-growths.

Caput. The head, also the chief part of an organ.

　　C. succedaneum. A swelling in or under the fetal scalp, composed of blood or serum, and due to pressure during delivery.

Carbol-fuschsin. A stain used in the identification of bacteria, particularly of the B. Tubercle.

Carbolic acid, phenol. (See Acid.)

Carbuncle. (See p. 117.) A deep-seated circumscribed suppurative inflammation of the subcutaneous tissue; differs from a boil in that it involves several points, forms less fluid pus, and is more persistent.

Carcinoma. "Cancer." Malignant tumor of epithelial origin.

Cardiac. Pertaining to the heart, "cardia." Also that portion of the stomach nearest the heart.

Caries. Necrosis or death of bone or teeth.

Carotid. "Artery." (See Anatomy.) The principal artery of the neck, supplying the brain, face, and head.

Carpal. Pertaining to the wrist.

Carron oil. Composed of equal parts of linseed oil and lime-water, used as first dressing for burns.

Caruncle. Any small fleshy growth, often about the urethra (see p. 220) and vagina.

Catamenia. The menstrual periods.

Catarrh. Inflammation of a mucous membrane, characterized by a profuse discharge, and no artificial membrane formation or tissue necrosis.

Cathartic. (See Pharmacy.) A drug used to produce evacuations of the bowels.

Catheter. A hollow tube to be inserted into a cavity through a normal opening, *i.e.*, into the bladder through the urethra, also the eustachian tubes.

Caustic. Irritating, burning, capable of destroying tissue.

Cautery. A metal instrument heated by electric current or actual flame, used to destroy tissue.

Cecum. (See Anatomy and p. 192 and Fig. 41.) The lower end of the ascending colon.

Celiac. Pertaining to the abdominal cavity, the "celom."

Celiotomy. A surgical operation, where the abdominal cavity is opened.

Cell. (See Anatomy.) The unit of structure.

Cellulitis. (See p. 19.) A diffuse inflammation involving loose tissue.

Centre. Usually N. centre. (See Anatomy and Physiology.) A group of nerve-cells in the brain or spinal cord which control special muscles or functions.

Cephalic. Pertaining to the head.

Cerebellum. (See Anatomy.) That portion of the brain located below the cerebrum, behind the pons varolii, and medulla oblongata.

Cerebrum. (See Anatomy.) The principal portion of the brain.

Cerebro-spinal. (See Anatomy and p. 98.) Pertaining to the brain and spinal cord.

　　C. canal. (See Anatomy and p. 103, Fig. 25.) The space extending from the ventricles of the brain through the length of the spinal cord.

　　C. fluid. (See Physiology and p. 103.) The serous fluid contained in the cerebro-spinal canal.

Cerumen. The waxy secretion formed in the external auditory canal.

Cervical. Pertaining to the neck (cervix), or to the structural neck of an organ. Example: the neck, cervix of the uterus.

Chancre. The primary syphilitic lesion or portal of entry.

Change of life. "Menopause." The normal cessation of the menstrual periods.

Chill. A condition characterized by sensations of cold and shivering, often the initial symptom of an acute infectious process and followed by a rapid rise in temperature.

Chloral hydrate. (See Pharmacology.) A hypnotic drug; dose gr. v-xx.

Chloroform. (See Pharmacology and p. 68.) A general anæsthetic.

Cholecystitis. (See p. 202.) Inflammation of the gall-bladder.

Cholecystectomy. (See p. 203.) The surgical removal of the gall-bladder.

Cholecystostomy. (See p. 202.) The drainage of the gall-bladder through a surgical incision of that organ.

Cholecystotomy. (See p. 204.) Exploration of the gall-bladder with immediate closure.

Cholelithiasis. (See p. 203.) The presence of calculi in the bile tract.

Cholestrin. (See Physiology.) One of the constituents of the bile, usually held in solution, but important pathologically in the formation of gall-stones.

Chondroma. (See p. 47.) A tumor containing cartilage.

Chronic. Of long duration; opposed to acute conditions.

Cicatrix. The scar formed in a wound, the newly developed connective tissue which fills in a loss of tissue from injury or infection.

Ciliated. (See Anatomy.) A type of epithelium.

Circulation. Passing in a circle, *e.g.*, blood. (See Physiology.)

Colateral C. (see p. 26), that which takes place through branches and anastomoses when the chief vessel is occluded.

Portal C., that from the digestive tract and spleen which is collected by the portal veins and passes through the liver capillaries, to be carried off by the hepatic veins to the vena-cava.

Pulmonary C., that from the right ventricle, through the lungs, and back to the left auricle.

Systemic C., the general circulation through the arteries, capillaries, and veins, as opposed to the portal and pulmonic.

Circumscribed. Limited, distinct from surrounding structures.

Cirrhosis. (See Medicine.) A chronic inflammatory process of an organ, characterized by overgrowth and infiltration of connective tissue, most often involving the liver.

Clavicle. (See Anatomy.) The collar bone.

Cleft-palate. (See p. 135.) A congenital fissure of the palate.

Climacteric. The period associated with the cessation of the menstrual periods; the menopause.

Clinic. At the bedside; an institution for the study and diagnosis of medical conditions.

Clinical diagnosis. That made as a result of examination of the patient and laboratory tests, before operation.

Clonic. Relating to spasmodic and convulsive muscular contractions, with alternating periods of relaxation.

Clot, "coagulation." (See Physiology.) A solidification of blood after it has been shed.

Coaptation. The accurate union or adjustment of the edges of a wound or fracture.

Cocaine. (See Pharmacy.) An alkaloid anæsthetic, used most often as the cocaine hydrochlorate, in solutions of from 1 to 5% as applications, or 1 to 500 hypodermically.

Colic. 1. Pertaining to the "colon" or large intestine. 2. A sharp pain in the abdomen supposed to be due to the spasmodic contraction of one of the hollow canals, bile-passages, intestinal tract, etc.

Collapse. Sudden severe depression of the circulation associated with hemorrhage, shock, or the rapid loss of large amounts of body fluid.

Colles. A celebrated British surgeon.

    C.'s fracture. (See p. 86.) That of the lower end of the radius.

Colon. (See Anatomy and p. 186.) The large intestine.

Colony. (See Bacteriology.) A growth of bacteria in culture media.

Colostomy. (See p. 187.) The surgical formation of a permanent opening in the large intestine to serve as an artificial anus.

Coma. A state of unconsciousness from which the patient can not be aroused.

Comminuted. (See Fractures, p. 78.) Broken into a number of pieces.

Compensatory. Making good a deficient function in another part.

Complication. A condition arising during the course of a disease and more or less dependent on it.

Compound complicated fractures. (See p. 78.) Open to the surface.

Conception. Fertilization of the female germ-cell, ovum, incidental to pregnancy.

Concussion. (See p. 106.) A pathological condition resulting from a blow, especially to the head.

Confinement. Childbirth.

Congenital. A condition or deformity existing at birth.

Congestion. An abnormal accumulation of blood in a tissue or organ.
    1. **Active C.,** due to an increase in the arterial supply.
    2. **Passive C.,** due to an obstruction to the venous return from the part.

Conjunctiva. (See Anatomy and p. 124.) The mucous membrane covering the eyeball, and lining the eyelids.

Consciousness. The state of being aware of one's own existence and mental impressions, also of the various sensory stimuli.

Constipation. Any condition where the bowels are evacuated irregularly, incompletely, or at abnormally long intervals.

Constitutional. A condition involving the entire body or organism.

Contagious. A condition or disease which may be carried or transmitted from one individual to another.

Contaminate. To soil with bacteria or material which is not sterile.

Contracture. A permanent shortening or contraction of a muscle, resulting in deformity or loss of function.

Contusion. A bruise or injury, usually without break of the surface.

Convulsion. (See Medicine.) An involuntary spasmodic contraction of muscles, either general or involving only special regions. May be (1) **clonic,** *i.e.,* alternating with periods of relaxation, or (2) **tonic,** without such periods.

Corium. (See Histology and p. 6.) The tissue layer underlying the skin.

Cornea. (See Anatomy.) The anterior transparent part of the eyeball.

Corrosive sublimate. (See Pharmacology.) The poisonous *Bichloride of Mercury* used in solutions of from 1-1000 to 1 to 10,000.

Cortex. The surface layer, cerebrum, kidney, etc.

Cover-glass. A thin piece of glass used to cover microscopical preparations.

Cradle. In surgery, a wire or wooden framework to keep the weight of the bed-coverings from an injured part of the body.

Cramp. A painful tonic contraction of a muscle.

Cranium. The skull. "Cranial," pertaining to the skull.

> **Craniotomy.** The surgical opening of the skull. (See p. 108.)

Cretinism. (See p. 143.)] A congenital condition due to absent or deficient thyroid secretion.

Crepitus. (See p. 79.) A sign produced by the friction of irregular bony surfaces in fracture, which can be felt and heard.

Crisis. A definite turning point, particularly in an acute infection.

Croup. A peculiar cough, produced by obstruction of the larynx.

> **Membranous C.** Due to fibrinous inflammatory exudate in the larynx usually caused by diphtheric infection.

Cultures. Growth of bacteria in artificial media for special study.

Cupping. A method of drawing blood to the surface and relieving congestion of deeper tissues, by the application of heated cups.

Cutaneous. Pertaining to the skin, or "cutis."

Cyanosis. A bluish discoloration of the skin, due to congestion with venous blood, or to a deficient oxygen content of the blood from local or general conditions.

Cyst. Any cavity containing fluid, surrounded by a definite limiting membrane or capsule. Also refers to the urinary bladder.

> **Cystic.** Pertaining to a cyst, also to the urinary or gall-bladder.
>
> **Cystitis.** Inflammation of the urinary bladder. (See p. 218.)

Cystoscope. An instrument introduced into the bladder, through the urethra, by means of which the mucous lining may be seen and studied.

Cystoscopy. (See p. 218.) The examination of the bladder by means of a cystoscope.

D

Decompression operation. (See p. 112.) That of relieving increased intracranial pressure by elevating depressed fragments of bone, or by removing a portion of the skull.

Decubitus. The position of the body of the patient. Also refers to a type of bedsore.

Defecation. The evacuation of the bowels.

Deformity. An abnormality of structure, congenital or acquired.

Degeneration. A pathological change in the elements of a substance or tissue, usually the breaking down from a complex to a simpler form.

> **Malignant D.** (See p. 42.) A change in the cell-structure of a new-growth by which it invades tissue and becomes malignant.

Delirium. A condition of extreme mental excitement and incoordination.

Dental. Pertaining to the teeth, "dens."

Dermal. Pertaining to the skin, "dermis."

Dermoid. Resembling the skin, derived from the skin. A special type of tumor containing various tissues derived from the skin.

Diabetes. (See Medicine.) A constitutional disease characterized by the presence of grape-sugar in the urine, and marked depression.

Diaphragm. (See Anatomy.) Any musculo-membranous partition, particularly that between the thoracic and abdominal cavity.

Diaphysis. (See p. 71.) The shaft of a long bone.

Diarrhœa. Any condition characterized by frequent and fluid bowel movements.

Digestion. The process by which the food is prepared so that it can be absorbed and assimilated in the body.

Diphtheria. (See Bacteriology and Pediatrics.) A type of infection characterized by toxæmia and local "membrane formation."

Diplococcus. (See Bacteriology.) A type of micrococcus, which occurs in pairs. Example: pneumococcus, gonococcus, etc.

Dirty. Surgically, anything which is not sterile.

Discharge. A pathological substance escaping from one of the body cavities or an infected surface.

Discrete. Separate, distinct from surrounding tissues.

Dislocation. Displacement of a part, organ or bone from its normal position.

Diuresis. An increase in the amount of urine secreted.

Diverticulum. A cavity or sac growing out of and communicating with a hollow organ or cavity; may be congenital or acquired.

Dorsum. The back, or that part of any structure corresponding to the back.

Dorsal. Pertaining to the back. ⁻

Douche. A stream of water directed against a surface of the body or into one of its cavities; may be cleansing, thermal (for heat effect) or antiseptic and medicinal.

Drain. Any material used to secure the removal of discharge from a wound or infected abscess cavity: glass, rubber, gauze or gutta-percha.

Dressings. Any material used to cover and protect a wound.

Duct. A channel through which the secretion of a gland is carried.

Dulness. Lack of resonance on percussion.

Duodenum. (See Anatomy, also p. 184.) The upper twelve inches of the small intestine.

Dura. (See Anatomy, also p. 101.) The outer covering of the brain and cord.

Dyspnœa. Difficult or labored breathing.

Dysuria. Painful urination.

Dysmenorrhœa. Painful menstruation.

E

Ecchymosis. The extravasation or escape of blood into the subcutaneous tissues, giving a bluish-black and later yellow discoloration.

Ectoderm. (See Anatomy.) The outer of the primary germ-layers.

Ectopic. In an abnormal position, *e.g.*, E. gestation, one outside of the uterus.

Eczema. (See Dermatology.) A skin-disease, chronic and non-contagious.

Edema. An infiltration of the tissues with fluid or serum.

Efferent. Carrying away from a centre, as opposed to afferent nerves, etc.

Effusion. A pouring out, or accumulation of clear fluid or serum into a cavity of the body, usually one of the serous cavities, pleura, etc.

Elective operation. One where the exact time is a matter of choice, as opposed to an *emergency* operation, which is urgently demanded.

Electrolysis. The dissolution of a chemical compound or a tissue by passing an electric current through it.

Emaciation. Marked loss of flesh.

Embolus. (See p. 95.) A portion of tissue or bloodclot carried in the blood-stream and blocking a smaller vessel by occluding its lumen.

Embryo. The product of conception especially during the first four months of intra-uterine life.

Emesis. Vomiting.

Empyema. A collection of pus or purulent fluid in a cavity. Example: pleural.

Encapsulated. Surrounded by a capsule.

Encysted. Enclosed in a definite wall or layer of connective tissue.

Endo. Within.

  Endocardium. Lining the heart.
  Endoderm. The primary embryonic layer lining the gastro-intestinal tract, etc.

Enema. An injection given into the rectum.

Entero. Referring to the intestinal tract.

  Enterostomy. An artificial opening, etc., particularly into the small intestine.

Enucleate. To shell out of a capsule, referring to tumors.

Enuresis. An involuntary emptying of the bladder.

Epigastrium. The region of the abdomen corresponding to the position of the stomach.

Epilepsy. (See Medicine.) A nervous condition characterized by repeated attacks of loss of consciousness and convulsive contractions of the muscles, more or less general in extent. *Jacksonian E.* (see p. 106.), convulsive attacks involving special regions or groups of muscles without loss of consciousness.

Epiphysis. (See p. 71.) A part of developing bone separated from the main structure by a layer of *Epiphysial cartilage* or *line,* which is later replaced by bone.

Epistaxis. (See p. 132.) Spontaneous hemorrhage from the nose.

Epithelium. (See Anatomy.) The specialized tissue-cells which cover the various body surfaces, and line the cavities which open on the surface.

Epulis. A tumor arising in the alveolar process of the jaw.

Erosion. A destruction or necrosis of superficial tissues.

Eructation. Belching, or bringing up gas or fluid contents from the stomach.

Erysipelas. (See Medicine and p. 32.) An acute infection of the skin and subcutaneous tissue, due to some variety of streptococci.

Ether, $(C_2H_6)_2O$. (See Pharmacology and p. 68.) Used hypodermically as a stimulant; dose: 5 to 10 min. Also general anæsthetic.

Ethyl chloride, C_2H_5CL. A gas kept in metal containers under pressure, used as a local or general anæsthetic.

Eustachian tube. (See Anatomy and p. 121.) A communication between the naso-pharynx and middle ear.

Excision. The surgical cutting away or removal of a part.

Excreta. The normal discharges from the body, particularly, feces and urine.

Exophthalmic. An abnormal protrusion of the eyeballs. (See goiter, p. 145.)

Exostosis. A bony outgrowth from the surface of a bone.

Expectant. Treatment, watching the progress of a condition and interfering only in case of emergency, or for special indications.

Exploratory operation. One which is done primarily to discover the cause of symptoms.

Extension. Straightening out a joint or flexed limb. In fractures, is the force applied to overcome deformity and shortening.

Extra. Without.

  Extradural. Outside the dura mater.

Extravasation. The passing of a fluid, urine, outside its normal cavity or duct, as a result of rupture or injury.

Exudation. The passing of fluid, serum or purulent material through the wall of a cavity, or into a serous space: pleura, etc.

F

Facet. A small flat surface of a bone, usually muscular attachment.

Facial. Pertaining to the face blood or nerve supply.

Facies. Expression, often typical in certain conditions: peritonitis, etc.

Fallopian. Named from Fallopius, a famous anatomist.

    F. tubes. (See Anatomy.) The oviducts.

Farcy. (See special works.) Glanders.

Fascia. A sheath or band of connective tissue; the term is also applied to loose connective tissue between muscles.

Febrile. Pertaining to fever, or increased body temperature.

Feces. The contents of the lower bowel, composed of undigested remains of the food and the excretions of the intestinal canal.

Felon, also "Paronychia." An abscess involving the terminal phalanx of the finger, usually a periostitis, but may be subcutaneous.

Femoral. Pertaining to the thigh, or femur. (See Anatomy: femoral vein, etc.)

Fetus. The product of conception during the latter five months of intra-uterine life.

    Fetal. Pertaining to the fetus.

Fever. (See Physiology.) An abnormally high body temperature.

Fibroid. (See p. 47.) A fibrous tumor.

    Fibroma. One which is largely composed of fibrous tissue or resembles it in structure.

First aid. The treatment given in emergency.

First intention. (See p. 50.) Aseptic wound healing.

Fissure. A cleft or groove. Also a crack or break in the mucous membrane lining any orifice of the body.

Fistula. (See p. 20.) An abnormal opening from a hollow organ to the surface of the body, or between two hollow organs.

Flap. A mass of tissue partly separated from its attachment or blood-supply.

Flatus. Gas or air contained in the intestinal tract.

Flexion. The bending of a limb or joint, the condition of being bent.

Floating. Freely movable; detached from its normal attachment.

Fluctuation. A wave-like motion transmitted by fluid in a cavity.

Fluoroscope. An apparatus for viewing deep structures; the Röntgen or "X-rays."

Focus. The site of a morbid or infectious process.

Follicle. A small secreting glandular mass or sac.

Fomentation. (See special works.) A warm moist dressing.

Fontanelle. (See Anatomy.) The spaces between the bones of the skull in infancy, before fusion or ossification is complete.

Foramen. A hole or perforation, particularly in bone or limiting membrane.

Forceps. An instrument composed of two blades and interlocking handles, used to grasp, compress, or pull an object.

    Dental F. For extracting the teeth.

    Hemostatic F. For compressing blood-vessels and controlling hemorrhage.

    Tissue or **dissecting F.** For grasping tissue in operating.

    Obstetrical F. Used in obstetrics to apply to the fetal head and to assist at delivery.

Formaldehyde. (See Pharmacology.) An irritating disinfecting gas.

Formalin. (See Pharmacology.) A 40% solution of formaldehyde in water.

Fossa. A shallow cavity, usually in bone.

Fowler's position. (See p. 170.) That which imitates the upright sitting posture and secures isolation of septic material in the abdomen.

Fracture. (See p. 78.) A loss of continuity of bony structure.

Frenum. A fold of skin or mucous membrane which limits the movement of a structure. (See Anatomy: tongue, foreskin, etc.)

Frontal. Pertaining to the frontal bone or forehead.

Fulminating. Coming on suddenly and increasing rapidly in intensity.

Fumigation. (See Hygiene.) Disinfecting by the use of gas or materials which destroy micro-organisms.

Function. The normal use or action of a part or organ.

Functional. Disease or disturbance involving the function but not the structure of a part

Fundus. The part of an organ most remote from its mouth or outlet.

Furuncle. A boil or local inflammation involving the corium and subcutaneous tissues, and containing a definite "core" or slough of necrotic tissue.

Fusiform. Spindle-shaped.

G

Gag. An instrument for holding the mouth open. Also refers to unsuccessful attempts to vomit.

Gall. The bile.

   Gall-bladder (see Anatomy and p. 206), the sac which serves as reservoir for the bile.

   Gall-stones, calculi which form in the bile.

Ganglion. (See Anatomy.) A group of nerve cells, outside of the central nervous system, which serve as a centre. Also, a cystic tumor or diverticulum of a tendon sheath.

Gas bacillus. (See Bacteriology and p. 35.) The *B. aërogenes capsulatus,* which produces gas in the tissues.

   Gas pains, those due to distention of the intestines with gas and painful peristaltic attempts to expel it.

Gastric. Pertaining to the stomach, ulcer, etc.

Gastritis. Inflammation of the mucous membrane of the stomach.

   Gastro-intestinal tract. The alimentary canal; including the œsophagus, stomach, small and large intestine, and secretory organs opening into the canal.

   Gastro-enterostomy. (See p. 175.) An artificial opening made surgically between the stomach and upper intestine.

Gavage. Forced feeding with a tube, usually by the stomach.

General. Involving the organism as a whole, as opposed to local.

Genital. Pertaining to the organs of reproduction or generation.

Genito-urinary. Pertaining to the genital and urinary organs.

Germ. A micro-organism or seed; also the early embryo or fertilized ovum.

Germicide. An agent which destroys germs.

Germ-layers. (See Embryology.) The primary tissue layers formed in the early development of the embryo.

Gestation. Pregnancy.

Giant-cell. An abnormally large tissue cell. *G. sarcoma* (see p. 48), one composed largely of unusually large connective tissue cells.

Gland. Any organ which separates a specific substance from the blood in the form of a secretion; may be internal into the blood, or external through a duct to a surface or cavity. The term is also improperly applied to more or less discrete masses of tissue, lymph-nodes, in which no such function has been demonstrated.

Glanders. (See Bacteriology.) An infectious disease of horses, occasionally transmitted to man.

Glioma. A new-growth composed of neuroglia-like cells found in the nervous tissues.

Glossal. Pertaining to the tongue.

Glottis. The opening between the vocal cords; also the portion of the larynx concerned in voice production.

Glycerin. (See Pharmacology.) A tri-atomic alcohol with marked affinity for water, used with tampons (vaginal) to abstract water from tissues; also as a vehicle for certain medicines.

Goiter. (See p. 144.) An enlargement or tumor of the thyroid.

Gonococcus. (See Bacteriology and p. 32.) The micro-organism causing gonorrhœa.

Gram's stain. An iodine stain used in bacteriological work to differentiate specific organisms.

Granulations. (See p. 23.) A type of connective tissue developing in healing wounds.

Graves's disease. Exophthalmic goiter. (See p. 145.)

Gravel. Calcareous matter in the kidney or bladder smaller than stones.

Groin. A region in the lower abdomen at its junction with the thigh.

Gum. A resinous substance; anatomically "gingiva." The fleshy structure covering the alveolar process and surrounding the teeth.

Gumma. A soft new-growth resembling granulation tissue, occurring in the tertiary stage of syphilis.

Gut. The intestine or bowel.

Gynecology. That branch of medicine which treats of women's diseases.

H

Hæmangioma. (See p. 48.) A tumor composed of blood-vessels.

Hæmatemesis. The vomiting of blood.

Hæmatocele. (See p. 55.) A cavity containing extravasated blood or serum the result of a broken-down blood-clot.

Hæmatoma. A solid mass of coagulated blood in the tissues.

Hæmaturia. The presence of blood in the urine.

Hæmophilia. An abnormal tendency to spontaneous or excessive bleeding, due to delay in the coagulation of the blood; usually hereditary, also rarely present as a temporary congenital condition at birth. Also in adults as a result of certain toxæmias, retention of the bile in chronic jaundice.

Hæmoptysis. The spitting of blood, as in pulmonary tuberculosis.

Hæmostasis. The control of hemorrhage.

Hanging-drop. (See Bacteriology.) A drop of water suspended on a cover-glass over a hollow-ground slide, used in bacteriology to study the motility of micro-organisms.

Hare-lip. (See p. 135.) A congenital deformity consisting of a cleft or fissure in the upper lip; may be single or double, often associated with a cleft-palate.

Haversian canals. (See Anatomy.) Minute canals in bone containing nutrient blood-vessels.

Hectic. An irregular chronic fever, often tubercular.

Hemorrhage. A sudden free flow of blood.

Hemorrhoids. "Piles" (see p. 189). Submucous tumors due to dilated or thrombosed veins of the rectal mucosa.

Hemostat. A forceps to compress and close a bleeding vessel.

Hepatic. Pertaining to the liver, "hepar": ducts, abscess, etc.

Hereditary. A condition which is transmitted from parent to offspring.

Hernia. (See p. 162.) The protrusion of the contents of a cavity or vessel through an opening or weakening in the wall.

Heroin. (See Pharmacology.) A hypnotic drug; dose gr. 1/24 to 1/12.

Herpes. (See Dermatology.) An inflammatory skin-disease, characterized by the production of blebs or vesicles.

Hexamethylen-amine. (See Pharmacology.) A urinary antiseptic; dose gr. x to xx.

Hiccup, hiccough. A sharp inspiratory sound due to a spasm of the glottis or diaphragm.

Highmore, antrum of. (See Anatomy and p. 131.) The bony cavity in the superior maxilla.

Hilum. The depression in certain organs where the nutrient vessels enter. (See Kidney, Spleen, etc.)

Hip. The region at the side of the pelvis, or about the articulation of the femur with the innominate bone.

Histology. The study of the microscopical structure of the tissues.

Hodgkin's disease. (See Medicine.) A condition characterized by chronic enlargement of the lymphnodes, local or general.

Hyaline. (See Anatomy.) A variety of cartilage covering the articular surfaces of the bones.

Hydrocele. A circumscribed collection of fluid, often in a tissue space or canal, particularly the inguinal canal or spermatic cord.

Hydrocephalus. (See p. 103.) A pathological condition characterized by an abnormal amount of cerebro-spinal fluid, with dilatation of the ventricles of the brain.

Hydronephrosis. (See p. 215.) A collection of urine in the pelvis of the kidney, due to obstruction of the ureter.

Hydrophobia. (See special works.) "Rabies," a disease transmitted by the bite of rabid animals, usually dogs.

Hydrotherapy. The use of water in the treatment of disease.

Hygiene. The care of the body and preservation of health.

Hyper-. Prefix meaning above or unusual.

　Hyperalgesia, excessive sensitiveness to pain.

　Hyperæmia, an unusual amount of blood in a part.

　Hyperemesis, excessive vomiting.

　Hyper-nephroma (see p. 214), a tumor derived from suprarenal tissue.

　Hyper-thyroidism (see p. 144), an abnormal condition due to excessive and atypical secretion of the thyroid gland.

　Hypertrophy, overdevelopment of an organ or tissue, usually in response to increased exercise or function.

Hypnotic drug. One which induces sleep: chloral, veronal, etc.

Hypo-. Prefix denoting deficiency or lack of: hypo-thyroidism (see p. 143); also, beneath or under.

　Hypodermic, under the skin or "dermis": injection.

　Hypodermoclysis, the introduction of large amounts of water or other solutions under the skin, to be absorbed.

　Hypophysis (see Anatomy and Physiology and page 109), an outgrowth, particularly a portion of brain: the pituitary body.

Hysterectomy. The surgical removal of the uterus; may be either abdominal or vaginal.

I

Ichthyol. (See Pharmacology.) A product obtained from fossil fish, used in 10% to 20% solution in glycerin to relieve pain due to inflammation.

Icterus. "Jaundice." (See p. 200.)

Ileo. (See Anatomy and p. 185.) Pertaining to the "ileum," the lower part of the small intestine.

　Ileo-cæcal, the junction of the ileum and cecum.

Ileus. Refers to obstruction of the bowel. (See p. 180.)

Iliac. Relating to the "*Ilium*," one of the bones of the pelvis. (See Anatomy.)

Immunity. (See Hygiene and p. 8.) The state of being protected from certain specific infections or pathological processes.

Immobilize. To fix parts, especially those of a fracture, in position.

Impaction. (See Fractures, p. 79.) Firmly imbedded or fixed; example, when the fractured ends of a bone are driven together.

Implantation. The grafting of a part or tissue.

Incarceration. (See Hernia, p. 162.) The fixation or imprisonment of a part in an abnormal position, so that it cannot be replaced.

Incision. Cutting into; a wound made with a sharp instrument.

Incontinence. The condition of being unable to control the evacuations of the bladder or bowel. Paradoxical I. (See p. 216.)

Incubation, period of. That from the time of exposure to a given infection till characteristic symptoms are present.

Indigestion. Properly refers to imperfect digestion. Also (see p. 172) is applied indefinitely to any gastro-intestinal disturbance.

Induration. Hardening, or a mass of hardened inflamed tissue.

Infarction. (See Pathology.) An area of degeneration in an organ or tissue, due to the cutting off of the blood-supply.

Infection. (See p. 9.) A pathological condition due to the invasion of the body with a specific microorganism.

Infiltration. The entrance into the tissue spaces or cells of an abnormal substance, or of an abnormal amount of a normal substance: water, serum, fat, connective tissue, etc.

Inflammation. (See p. 9.) The changes in the body tissues which occur as the result of local irritation or infection.

Influenza. (See Medicine.) An acute infection involving especially the respiratory tract, also other parts of the body.

Infraction. (See p. 78.) An incomplete fracture, with no displacement.

Infra-. Prefix meaning below. Infrascapular, etc.

Inguinal. A region of the lower abdomen, relating to the groin.

Inhibition. (See Physiology.) Checking or restraining activity of organs.

Injection. The act of forcing or injecting substances, usually fluids, into the body tissues, cavities, or vessels; *e.g.*, **Hypodermic,** under the skin; **Intra-uterine,** into the uterus; **Intravenous,** etc.

Innocent. Applied to new-growths (see p. 42), benign, non-malignant.

Inoculation. The introduction of specific infectious material into the tissues of an individual.

Inoperable. Applied to conditions which are so far advanced that they can not be corrected by operation.

Instrumental. Accomplished with the aid of instruments, especially childbirth.

Intestinal. Relating to the small and large intestine.

Intoxication. Poisoning from any cause.

Intra-. Prefix meaning within. Intra-uterine, etc.

Intubation. (See special works and p. 146.) The operation of introducing a hollow tube into a structure, especially the larynx, when that structure is occluded by diphtheric inflammation and respiration is obstructed.

Intussusception. (See p. 180.) The invagination or slipping of a part of the intestine into the part beyond, causing intestinal obstruction, and later strangulation.

Inunction. The act of rubbing an oily medication into the skin, also the substance used, often mercury in some form.

Involuntary. An action performed independently of the will and beyond one's conscious control.
    I. muscle (see Physiology), the non-striated or vegetative muscle. Example: that of the intestinal tract.

Involucrum. (See Pathology and p. 74.) The bony sheath surrounding the cavity which results from infection of bone.

Involution. The changes which an organ undergoes after fulfilling its function. Example: uterus after labor.

Iodine. (See Pharmacology.) A non-metallic crystalline element, irritating, used in 5 to 10% solution (tincture) in alcohol, as a local antiseptic and counter-irritant.

Iodoform. (See Pharmacology.) An antiseptic powder, used on gauze as a dressing for wounds, or in oil as an injection into infected cavities.

Iris. (See Anatomy.) The circular pigmented membrane placed between the cornea and the lens, limiting the central opening or pupil.

Ischemia. A local anemia.

Ischiatic. Pertaining to the ischium. (See Anatomy of the Pelvis.)

Ischio-rectal. The region between the rectum and the ischial bones.

J

Jaundice, "icterus." (See p. 200.) A yellow pigmentation of the skin due to the retention within the body of bile-pigments.

Jejunum. (See Anatomy and p. 185.) The upper three-fifths of the movable part of the small intestine.

Joint. (See Anatomy and p. 89.) Articulation; the movable union of two or more bones.

> **False J.,** abnormal mobility resulting from the imperfect union of a fracture.
>
> **Joint-mouse,** an abnormal solid substance in the cavity of a joint.

Jugular vein. (See Anatomy.) The principal vein of the neck and head. Pertaining to the region of the throat.

K

Keloid. A fibrous new-growth, usually resulting from an overdevelopment of scar tissue in a healing wound.

Knee. The articulation between the femur and tibia. (See Anatomy.)

> **K.-cap.** The patella.
>
> **K.-chest position,** with the patient resting on the knees and chest; used in gynecological examinations and treatments. (Fig. 45).

Kyphosis. An angular deformity of the vertebral column, with a prominence to the back.

L

Labium. A lip. Example: labium major and minor of the vulva. (See Anatomy).

Labor. Childbirth or delivery.

Laceration. A wound resulting from tearing, not having clean cut edges. Especially the wounds of the female perineum occurring in labor.

Lachrymal. (See Anatomy.) Referring to the tears.

Laparotomy, also CELIOTOMY. (See p. 161.) An operation made through the abdominal wall.

Lateral. At the side of; away from the mid-line.

Lavage. Washing out a cavity, particularly the stomach.

Laxative. A mild cathartic.

Leg. The lower extremity from the knee to the ankle.

Lesion. An injury, wound or local diseased area.

Leukæmia. A blood-disease characterized by an anemia and increase in the number of white blood-cells or "leucocytes."

Leucocytosis. (See p. 13.) The increase in the number of leucocytes which occurs in certain acute infections.

Levator ani muscle. (See Anatomy.) The pair of muscles which form the floor of the pelvic cavity.

Ligament. A band of dense fibrous tissue connecting the ends of articulating bones, reinforcing the joint capsule.

Ligature. Thread, catgut, or material used to tie about blood-vessels, and control bleeding.

Limb. One of the extremities of the body, usually the lower.

Line. Anatomical, any structure or attachment having length, with only slight thickness.

> **Linea alba.** (See Anatomy.) The fibrous union of the sheath of the rectus abdominales muscles.

Lingual. Pertaining to or resembling the tongue.

Liniment. Any fluid to be applied to a part by friction and massage.

Lip, "labium." A fleshy fold surrounding the orifice of a cavity: the mouth.

Lipoma. (See p. 47.) A new-growth composed of fatty tissue.

Liquor. (See Pharmacy.) A solution of a non-volatile substance in water.

    L. cresolis compound. Similar to *Lysol*, an antiseptic derived from crude carbolic acid, used in solution of $\frac{1}{4}$ to $\frac{1}{2}\%$.

Lithiasis. The formation of calculi or calcareous concretions in the body.

Lithotomy. A surgical incision of the bladder for the removal of urinary concretions. (See p. 219.)

Lockjaw. A popular name for "tetanus." (See p. 34.)

Lues. "Syphilis." (See p. 37.)

Lordosis. An abnormal anterior curvature of the vertebral column.

Lumbar. Pertaining to the region of the loin.

    L. puncture. (See p. 105.) The insertion of a hollow needle or trocar between the lumbar vertebræ, into the subarachnoid space of the spinal cord. This may be done for diagnosis; to study the pressure and composition of the cerebro-spinal fluid; for treatment to relieve increased pressure in certain conditions; to administer antitoxine, or drugs, or anæsthetics.

Lupus. (See Dermatology.) A chronic skin-disease.

Luxation. Dislocation of a joint. (See p. 90.)

Lying-in period. That during confinement and convalescence.

Lymph. (See Physiology.) The fluid in the tissues which is collected in the lymph-vessels.

Lymph-nodes. (See Anatomy and p. 12.) Discrete masses of tissue, the cells of which resemble and give rise to the lymphocytes in the blood.

Lymphangitis. An inflammation involving the lymphatic vessels.

Lymphadenitis. Inflammation of the lymph-nodes. (See pp. 14, 97.)

Lysis. Solution; the gradual recovery from a disease; fever.

Lysol. A proprietary preparation similar to liquor cresolis comp.

M

Maceration. Softening, or breaking down mechanically.

Major operation. One which involves extensive procedures or risk of life.

Malaise. A feeling of weakness and sickness.

Malar. (See Anatomy.) The cheek-bone.

Malaria. (See Medicine.) A fever due to infection by a special parasite introduced by the bite of the female anopheles mosquito.

Malignant. Bad, virulent, threatening life.

    M. tumor (see p. 43), one which is not encapsulated, extending into the neighboring tissues, carried to other parts of the body, forming *metastases*, and recurs after incomplete surgical removal.

Malingerer. One who feigns sickness or injury.

Mallein. A specific antitoxine for glanders.

Malleolus. (See Anatomy.) A small bony prominence.

    M. external and **internal.** In relation to the ankle-joint.

Mamma. (See Anatomy and p. 156.) The breast.

Mammillary line. A perpendicular line extending through the nipple.

Mandibular. Pertaining to the mandible or lower jaw.

Marrow. (See Anatomy and p. 74.) The fatty and vascular contents of the central cavity of bones. Also, the central part of any structure.

Mastitis. (See p. 156.) Inflammation of breast-tissue.

Mastoid cells or **antrum.** (See Anatomy and p. 131.) The cancellous bony process of the temporal bone, behind the external ear.

Maxillary. Pertaining to the jaws.

Meatus. The opening of a narrow passage: urinary of the urethra.

Mediastinum. (See Anatomy.) The space in the thoracic cavity, between the lungs, containing the heart, great vessels, trachea, and œsophagus.

Medicine. The general consideration and treatment of disease, often limited to internal diseases and those treated by non-operative or non-instrumental measures, as opposed to surgical means.

Medulla oblongata. (See Anatomy.) That portion of the brain continuous with the spinal cord below, the cerebellum and pons varolii above.

Medullary marrow. Central portion of a structure.

Melanin. A black pigment found in the choroid layer of the eye and in the deep layers of the skin. Also found in certain malignant new-growths, the *melano-sarcoma*. (See p. 48.)

Membrane. A thin flat layer of tissue, surrounding a part or separating structures. *Membrane bone.* (See p. 73.)

Meninges. (See Anatomy and p. 101.) The membranes surrounding the brain and spinal cord; include the pia and dura mater, and the arachnoid.

Meningocele. (See p. 117.) A hernial sac through an abnormal opening in the skull or vertebral column, composed of one or more layers of meninges and containing cerebro-spinal fluid.

Menopause. The normal cessation of the regular monthly menstruations.

Menorrhagia. Excessive menstrual bleeding.

Mercury. (See Pharmacology.) Quicksilver, a fluid metallic substance. Various preparations of the metal and its salts are used medicinally.

Mesentery. (See Anatomy and p. 166.) A fold of peritoneum surrounding and suspending the intestine and certain of the abdominal viscera.

16

Mesoderm, *"mesoblast."* (See Embryology.) The middle of the three "primary germ-layers"; gives rise to the vascular, muscular and supporting tissues.

Metabolism. (See Physiology.) The process by which living beings transform foodstuffs into tissue substance.

Metacarpal. (See Anatomy.) Pertaining to the wrist.

Metamorphosis. A change in structure or a degeneration.

Metastasis. (See p. 43.) A secondary tumor or new-growth, formed from cellular elements carried in the blood or lymph stream.

Metatarsal. (See Anatomy.) Pertaining to the ankle.

Meteorism, "tympanites." The distention of the abdomen due to gas in the intestinal tract.

Metritis. Inflammation of the uterus.

Metrorrhagia. Uterine bleeding between menstrual periods.

Microbe. A living organism of microscopic size; bacterium, microorganism.

Micturition. The act of voiding urine, emptying the bladder.

Milk-leg. (See p. 95.) The swelling of a limb due to the obstruction of the principal vein or the lymphatic vessels.

Minor operation. One involving only simple procedures and slight risk.

Miscarriage. The expulsion of the fetus between the fourth and sixth month of intra-uterine life. Often not thus limited.

Mole. 1. A bloody mass or degenerated ovum expelled from the uterus. 2. A type of skin-tumor composed of lymphatic tissue.

Montgomery's glands. (See p. 155.) Small sebaceous glands in the areola surrounding the nipple, most evident during pregnancy.

Morbidity. Sickness, ill-health. The rate of sickness.

Morphine. (See Pharmacology.) An alkaloid derived from opium, used to relieve pain, usually hypodermically; dose **gr.** $\frac{1}{8}$ to $\frac{1}{4}$.

Mortality. The death-rate.

Motile. Capable of spontaneous motion.

Motor nerves. Those which supply voluntary muscles, and which when stimulated induce motion.

Mucosa. A membrane composed of cells which secrete *mucus*, a viscid secretion. (See Physiology.)

Mumps. (See Medicine and p. 129.) An acute infection characterized by a non-suppurating inflammation of the parotid glands.

Mural. Pertaining to the wall of a structure, *e.g.*, the uterus.

Murmur. A rough sound produced by fluid flowing through an irregular opening, *e.g.*, diseased heart-valves, into an aneurismal cavity.

Muscle-spasm. An involuntary contraction of a voluntary muscle, which protects an underlying sensitive part from sudden pressure.

Myoma. (See p. 47.) A tumor derived from muscle tissue, usually non-striated, *e.g.*, from the uterus.

Myxedema. (See p. 143.) A pathological condition due to deficient thyroid secretion. Characterized by infiltration of the subcutaneous tissue with fluid, and also mental changes.

N

Narcosis. A state of more or less complete unconsciousness and muscular relaxation, induced by special drugs, *Narcotics*.

Nasal. Pertaining to the nose.

Naso-pharynx. (See Anatomy.) That part of the pharynx above the soft palate and continuous with the nasal passages.

Nausea. A desire to vomit.

Neck, "*cervix*." Anatomically limited by the angle of the jaw and mastoid above, and the clavicle below. Also applied to the narrow portions of certain structures, *e.g.*, uterus, humerus, etc.

Necrosis. (See p. 10.) Death of cells or tissues.

Neoplasm. A tumor or new-growth.

Neosalvarsan. (See Pharmacology.) A proprietary specific remedy for syphilis.

Nephrectomy. The surgical removal of a kidney.

Nephritis. Inflammation of kidney tissue, usually non-suppurating.

Nerve-trunk. (See Anatomy and p. 113.) A cord-like structure composed of nerve-fibres or *axis cylinder processes* from nerve-cells ("neurones") and surrounded by a protective sheath, capable of transmitting nerve impulses.

Nerve-centre. A group of nerve cells, neurones, which are concerned in the supply of a special group of muscles or a special function.

Nervous system. (See Anatomy.)
Central, includes the brain and spinal cord, and sympathetic ganglia.
Peripheral, includes the various nerve-trunks in the body.

Neural. Pertaining to the nervous system or tissue.

Neuralgia. Severe paroxysmal pain along the course of a sensory nerve, the cause of which is usually not demonstrable.

Neuritis. Inflammation of a nerve-trunk, usually painful.

Neuroma. (See p. 48.) A new-growth in connection with or derived from nervous tissue.

Neurone. A nerve-cell. (See Anatomy and p. 98.)

Nevus. (See Pathology and p. 48.) A circumscribed area of pigmentation; a new-growth composed of lymph or blood-vessels, usually congenital.

New-growth. (See p. 40.) Tumors, benign and malignant.

Nipple. (See Anatomy and p. 154.) The pigmented projection from the surface of the breast, containing the milk ducts.

Nitrous oxide. (See Pharmacology and p. 68.) A gas used to induce narcosis and general anæsthesia.

Noble's enema. One given to stimulate active peristalsis in certain cases of suspected intestinal obstruction. Formula:

Glycerin	2 parts
Magnesium sulph.	2 parts
Water	4 to 8 parts

Node. A small mass of tissue. Example: lymph-node.

Noguchi's test. A specific reaction given by individuals having syphilis.

Noma. Gangrenous ulceration of the mouth.

Normal. Usual, typical.

    N. saline, or salt solution, one which contains the same percentage of sodium-chloride as the blood (0.6 per cent.).

Novocaine. (See Pharmacology.) A derivative of cocaine, used for local anæsthesia by hypodermic or intraneural injection in solutions of 1-500. Said to be less toxic than cocaine.

O

Obstetrics. That branch of surgery dealing with pregnancy and childbirth.

Obstipation. Extreme and persistent constipation.

Obstruction. Hindrance to the normal passage of the contents of a canal; usually refers to

    Intestinal O. (See p. 180.)

Obturator. A plug or plate which closes an opening. Example: aspirating trocar or proctoscope.

Occiput. (See Anatomy.) The posterior protuberance of the skull.

Occlusion. The state of being blocked, applied to canals and vessels.

Omentum. (See Anatomy and p. 166.) A folding of the mesentery.

Open fracture. (See p. 78.) One which is exposed to the air and infection, *i.e.*, not covered by unbroken skin or mucous membrane.

Operation. A therapeutic measure performed with instruments or by the surgeon's hands.

Ophthalmia. (See special works.) An inflammation involving the eye or the conjunctival sac.

    O. neonatorum. (See p. 33.)

Ophthalmic. Pertaining to the eye.

Ophthalmoscope. An instrument for examining the retina of the eye.

Opisthotonus. A form of tetanic spasm, characterized by a bending of the body so that it rests on the head and heels.

Opsonins. (See special works.) Substances formed in the blood which are supposed to increase the activity of the white blood-cells, phagocytes, in attacking certain specific bacteria.

Organ, *"viscus."* A group of tissues in the body, having a special function.

Organic. Pertaining to an organ, also to substances associated with or derived from organized, living structures.

Organism. A living plant or animal.

Orifice. The entrance or outlet to a body-cavity.

Orthopædic. Pertaining to the correction of deformities, especially in children.

Os. A bone.

    O. innominatum.

Osseous. Composed of or resembling bone.

Ossification. (See Anatomy.) The formation or development of bone.

Osteitis. (See p. 74.) Inflammation of bone.

Osteoblast. (See p. 73.) A cell which is specifically active in the development of bone.

Osteoclast. An instrument used to produce surgical fracture of a bone to correct deformity. Also (see Anatomy), the cells which destroy the primary cartilage bone, preceding the developement of the permanent membrane bone.

Osteoma. (See p. 47.) A new-growth containing bone-tissue.

Osteomyelitis. An inflammation of bone, particularly that involving the bone-marrow.

Osteum. A mouth or opening to a cavity.

Otitis. Inflammation of the ear.

    O. media, of the middle ear.

Ovary. (See Anatomy.) The special female sex-gland from which the ova are formed.

Oviduct. (See Anatomy.) The fallopian tubes, leading from the cavity of the uterus to the peritoneal cavity near the ovary.

Ovariotomy. The surgical removal of the ovary.

Ovum. (See Anatomy and Physiology.) An egg; the female sexcell, which after fertilization, "conception," gives rise to the embryo or offspring.

Oxalates. (See Physiology.) Salts of oxalic acid formed in the body and excreted in the urine, normally held in solution or found as crystals. Pathologically important in forming calculi or concretions.

P

Pack. Treatment by wrapping a patient in blankets, dry or wet, either hot or cold. (See special works.)

Paget's disease, after a famous English surgeon. (See p. 156.) An eczematous-like eruption about the nipples, malignant.

Pain. Distress or suffering.

    Labor pains refer to contractions of the uterus in confinement, usually causing conscious pain.

Palate. (See Anatomy and p. 135.) The roof of the mouth.

    Soft P., the uvula.

Palliative treatment. Measures to relieve symptoms but do not directly influence the causal condition.

Pallor. Paleness; absence of color in the surface of the body in anemia, or following extensive hemorrhage.

Palmar. Referring to the palm or flexor surface of the hand.

Palpation. Examination of the patient by the hand, depending on the sense of touch.

Palpebral. Referring to the eyelid, usually the upper.

Papilla. A small conical or nipplelike projection from an epithelial surface.

Papilloma. (See p. 45.) A newgrowth from any epithelial surface.

Para. A prefix meaning near or associated with: *para-urethral, para-metrium.*

Paracentesis. The surgical puncture of a cavity (pleural) with a hollow needle or trocar.

Paralysis. Loss of the power of motion.

Parasite. An organism which lives within and at the expense of another, the "host," and usually to the detriment of the latter.

Parathyroid glands. (See Physiology.) Small structures near the thyroid having an important internal secretion.

Parenchyma. The special functioning tissue of a structure, as opposed to the supporting tissue.

Parietal. Pertaining to the wall of a cavity, also parietal bone (see Anatomy).

Parotid gland. (See Anatomy.) The salivary gland located in the cheek.

Parturition. The process of childbirth.

Paste. (See Pharmacology.) A semi-fluid, viscous substance, usually containing a medicine. Example: Beck's paste, containing bismuth in vaseline.

Pasteur treatment. A specific treatment for hydrophobia, named for Louis Pasteur, a famous French scientist.

Patella. (See Anatomy.) The kneecap.

Patent. Open, patulous; applied to a canal or vessel.

Pathogenic. A micro-organism causing disease.

Pathognomonic. A symptom or a sign pointing directly to a specific cause or disease.

Pathology. That branch of medicine which treats of abnormal tissue changes and structural causes of disease.

Pedicle. A narrow portion of a tumor containing the nutrient vessels and nerves, serving as the attachment of the tumor.

Pedunculated. A mass attached by a pedicle, or *peduncle*. (See p. 45.)

Pelvis. A basin-like structure; unless qualified, refers to the bony structure formed by the sacrum and innominate bones. (See Anatomy). Also,

    Kidney P. (see Anatomy and p. 207), the sac or collecting portion of the kidney, continuous with the ureter.

Per. Prefix meaning through or by way of.

    P. anum, given by the anus.

Peri. Prefix meaning about or surrounding. *Perirectal fat.*

Pericardium. (See Anatomy and p. 154.) The serous sac surrounding the heart.

Perichondrium. (See Anatomy.) The fibrous and nutrient membrane surrounding cartilage.

Perineum. (See Anatomy.) The region between the anus and the external genitals.

Periosteum. (See Anatomy and p. 73.) The fibrous and nutrient membrane surrounding bone.

Periostitis. (See p. 75.) Inflammation of the periosteum and underlying bone.

Peripheral. Away or remote from the centre. *Peripheral nerves.*

Peristalsis. (See Physiology.) The rhythmical contractions of the muscles of the hollow viscera, gastro-intestinal tract, by which the contents are carried through to the rectum.

Peritoneum. (See Anatomy and p. 165.) The serous membrane lining the abdominal cavity, covering certain organs, and forming folds, *mesentery* and omentum.

Peritonitis. (See p. 167.) An inflammation involving the peritoneum.

Peroxide. (See Pharmacology.) Any oxide which contains oxygen easily given off under favorable conditions.

Hydrogen p., H_2O_2, which gives off an atom of oxygen in the presence of organic matter, blood.

Pessary. An instrument to be retained in the vagina for the purpose of supporting the uterus.

Phagedena. A rapidly spreading ulcer.

Phagocyte. Leucocyte, a blood-cell which destroys micro-organisms or foreign bodies in the tissues.

Phalanx. (See Anatomy.) One of the bones of the fingers or toes.

Pharyngitis. An inflammation of the *pharynx*. (See Anatomy and p. 137.)

Phenol. Carbolic acid.

Phlebitis. Inflammation involving or extending along a vein.

Phlebotomy. Incision into a vein; bleeding.

Phlegmasia. Thrombosis. (See p. 95.)

Phlegmon. A form of abscess in connective tissue.

Phthisis. Wasting of the body; usually refers to pulmonary tuberculosis.

Pia mater. (See Anatomy.) The inner layer of the meninges.

Pigment. A coloring matter, usually derived from the blood.

Piles. A popular term for hemorrhoids.

Pimple. (See p. 11.) A small localized infection in the skin.

Pituitrin. (See Pharmacology.) An active principle derived from the pituitary gland, used hypodermically to stimulate contractions of involuntary muscle: the uterus during labor or the intestine in post-operative distention.

Plantar. Refers to the sole of the foot.

Plasmodium. A form of blood parasite.

Plaster. A tenacious substance for spreading on the surface of the body: for mechanical support, adhesive; counter-irritation, mustard, etc.

Plaster of paris bandage. Gauze bandage impregnated with calcium sulphate, put on wet and allowed to harden, forming a rigid dressing for fractures.

Plastic operation. One which repairs loss of tissue or deformity.

Pleurisy. An inflammation involving the *pleura* (see p. 153), the serous membrane surrounding the lungs.

Pneumonia. (See Medicine.) An inflammatory process involving the tissue of the lungs.

Pneumo-thorax. (See p. 151.) An opening between the pleural cavity and the exterior or the bronchial passages.

Pneumococcus. (See p. 33.) A variety of bacteria.

Polypus, polyp. (See p. 45.) A pedunculated growth from a mucous surface, protruding into a cavity or passage: bladder, uterus, or nasal passage.

Pons varolii. (See Anatomy.) The portion of the brain below the cerebrum and in front of the cerebellum.

Portal. Pertaining to the liver and portal circulation.
  P. of entry (see p. 7), the primary focus of an infectious process.

Position. A special attitude of a patient for examination or treatment: Fowler's, Sim's, knee-chest, etc.

Posterior. Situated behind or at the rear.

Post. Following or after.
  Post-mortem, after death, or autopsy.
  Post-operative, after operation.
  Post-partum, following delivery.

Potassium. (See Pharmacy.)
  P. iodide, a salt used in the specific treatment of syphilis.
  P. permanganate, an oxidizing germicide used in solutions of 1 to 5000 to 1 to 10,000.

Pott's disease. (See p. 75.) Tuberculosis of the vertebral column.

Pott's fracture (see p. 88), that involving the lower end of the fibula above the external malleolus.

Poupart's ligament. (See Anatomy.) That extending from the anterior superior spine of the ilium to the sine of the pubes, in relation to the inguinal canal (see p. 165).

Predisposition. A special individual tendency to some particular disease.

Premature. Occurring before the proper time.

Preventive. Treatment or measures taken to avoid the occurrence of a particular condition.

Probang. A flexible rod, with special apparatus at the end for engaging foreign bodies, especially in the throat.

Probe. A slender flexible blunt instrument for exploring sinuses or cavities.

Procto. Referring to the rectum or lower bowel.
  Proctoclysis, the injection of fluid into the rectum by the drop method, to be retained.

Proctoscope. An instrument which exposes the mucosa of the rectum for examination.

Prodrome. A characteristic symptom which occurs early in the course of a disease.

Prognosis. A judgment concerning the probable outcome of a pathological condition.

Prolapse. A falling or dropping of an organ or structure from its normal position.

Pronation. The position of the forearm with the palm of the hand upward.

Prophylactic. Preventive measures taken to ward off disease.

Prostate. (See Anatomy.) A glandular structure, present in the male, surrounds the urethra at the base of the bladder. Enlargement or hypertrophy is not infrequent in middle-age and causes obstruction to the complete emptying of the bladder, resulting in the accumulation of *residual* urine (see p. 220).

Proud flesh. (See p. 23.) Excessive collections of exuberant granulations.

Ptosis. (See p. 160.) A falling or sagging of a part. Intestine, stomach, etc.

Puberty. That period of life during the development of the generative organs, from 12 to 14 years.

Pubes. (See Anatomy.) The region of the symphysis or articulation of the pubic bones.

Puerperium. The period including childbirth and recovery.

Pulmonary. Referring to the lungs and respiratory tract.

Pulse. (See Physiology.) The wave of increased pressure due to the contraction of the heart, and which is transmitted through the systemic arteries.

Punctured wound. (See p. 50.) One made with a sharp piercing instrument.

Pupil. The clear space at the centre of the iris of the eye, through which light-waves reach the sensitive *retina*.

Purulent. Fluid, serum, or discharge which contains pus visibly.

Pus. (See p. 10.) Necrotic white blood-cells; also, tissue cells destroyed by infection.

Pustule. A local infection in the skin containing pus.

Putrefaction. Abnormal decomposition of organic substances.

Pyelitis. Inflammation of the kidney pelvis (see p. 211).

Pyuria. Pus in the urine.

Pyorrhea alveolaris. (See p. 134.) Infection about the roots of teeth in the alveolar process. *Riggs's disease.*

Pylorus. (See Anatomy.) That part of the stomach continuous with the duodenum (see p. 174).

Pyonephrosis. Suppuration with accumulation of purulent material in the kidney pelvis (see p. 211).

Q

Quinine. (See Pharmacology.) A bitter alkaloid used in febrile attacks, a specific for malaria.
   Q. and urea hydrochloride. (See p. 69.) Used hypodermically or intra-muscularly for local anæsthesia.

Quinsy. Suppuration and abscess-formation about the tonsil.

R

Rabies, "hydrophobia." (See special works.)

Radial. Pertaining to the radius and that part of the forearm.

Radiogram, "skiagram." A photographic plate exposed to the Röntgen rays.

Ranula. (See p. 137.) A cystic tumor beneath the tongue, due to the occlusion and dilatation of the duct from the salivary gland.

Reaction. The response of a part or organ to stimulation; also, a chemical change.

Rectum. (See p. 186.) The lower fixed portion of the large intestine below the sigmoid, opening at the anus.

Rectus. Straight perpendicular.
   R. abdominis (see Anatomy and p. 159), one of the muscles of the abdominal wall.

Reduction. The restoration of a displaced part to its normal position. Example: a fractured bone, dislocated joint, hernial protrusion.

Reflex. (See Physiology.) An involuntary response to stimulus.

Regurgitation. A backflow or reversal of the course of fluid contents in the gastro-intestinal tract or blood-vessels.

Renal. Pertaining to the kidney.

Resection. The surgical removal of a part or organ.

Residual. The part retained within a cavity after voluntary expulsion. Example: residual urine.

Resolution. The return of tissues to normal after physiological activity, pregnancy; or pathological processes, the lung after pneumonia, or tissues after an abscess. (See p. 10.)

Retro-. Prefix meaning behind, or at the rear of. *Retroperitoneal.*

Rhachitis, "rickets." (See Medicine.) A constitutional disease of early childhood, characterized by defective bone-formation and later deformities.

Rheumatism. (See Medicine.) A specific infection. Improperly applied to numerous conditions associated with pain in the muscles or joints.

Rib. (See Anatomy and page 150.) **Floating ribs,** the two lower pairs which are unattached at their anterior ends.

Riggs's disease. Pyorrhœa alveolaris. (See p. 134.)

Ring. A normal opening through a muscular wall: *Inguinal.*

Rongeur forceps. An instrument used to bite off and remove bone.

Round ligament. (See Anatomy.) One of the ligaments of the uterus.

Rupture. A forcible tearing of a structure: also, refers to hernia.

Rudimentary. An organ or part which is not functioning and is degenerated.

S

Sacro-iliac. (See Anatomy.) Relating to the articulation of the sacrum and ilium.

Saline. Salty compounds, especially those of sodium, magnesium, and potassium. Also, normal sodium-chloride solution.

Saliva. (See Physiology.) The mixed secretion of the parotid, sublingual, and submaxillary glands.

Salivation. A condition due to poisoning with mercury, characterized by tender gums and excessive flow of saliva.

Salol. (See Pharmacy.) A compound of phenol and salicylic acid.

Salpingo. Relating to the fallopian tubes; also the Eustachian tubes.

Salvarsan. (See Pharmacology.) A proprietary preparation used in the specific treatment of syphilis.

Sapremia. A mild febrile condition due to the absorption of toxic substances (ptomaines) from putrefaction, possibly low-grade infection.

Saprophytic. (See Bacteriology.) Micro-organisms which grow in dead organic material.

Sarcoma. (See p. 48.) A malignant new-growth derived from and resembling some type of connective tissue.

Scab. (See p. 43.) A crust formed by the drying of secretions covering an ulcerating area.

Scalp. (See p. 116.) The skin and subcutaneous tissue covering the vault of the skull, the hairbearing area.

Scalpel. A small knife having a convex cutting edge.

Scar. (See p. 50.) "Cicatrix."

Sciatic nerve. (See Anatomy.) The motor and sensory nerve in the posterior part of the thigh, supplying the leg and foot. Also refers to the region where the nerve passes through the pelvis.

Scirrhus. A form of hard tough cancer.

Sclera. (See Anatomy.) The dense white portion of the eyeball.

Sclerosis. (See Pathology.) A hardening, usually with degeneration and infiltration of the tissues with fat and calcium deposit.

Scoliosis. (See p. 150.) A lateral curvature of the vertebral column.

Scrotum. (See Anatomy.) The pouch, composed of skin, connective tissue and fascia, which contains the testicles.

Scybala. Hard fecal masses.

Searcher, stone. A hollow metal tube or probe introduced through the urethra into the bladder, to detect the presence of calculi.

Sebaceous glands. Those about the hair follicles, having a characteristic secretion, *sebum.*

Section. Cutting, abdominal section, laparotomy.

Secretion. A substance which is separated from the blood by the specific action of certain tissues, usually collected in ducts and carried into a cavity of the body for a special purpose; or is carried to the surface as a waste *excretion*.

> **Internal S.,** one which is taken up by the circulating blood or body fluids and has metabolic influence.

Sedative. Quieting, lessening functional activity.

Sepsis. (See p. 9.) The morbid general condition produced by local infection.

Septic. Due or related to sepsis. Also, any material capable of causing sepsis.

Septum. A partition or dividing wall between two cavities or passages.

Sequela. A pathological condition following and directly due to some particular disease.

Serous. Pertaining to or secreting serum, or similar fluids.

Serum. (See Physiology.) The clear fluid separated from the blood.

Sessile. (See p. 45.) A mass or tumor which has a broad attachment and is not pedunculated.

Shin. The anterior tibial region of the leg.

Shock. (See p. 63.) A sudden depressed general condition affecting the circulatory system.

Sigmoid. An S-shaped structure.
> **S. flexure** (see Anatomy), a movable loop of the large intestine, above the rectum.

Sign, physical. An objective change or reaction in a patient which can be demonstrated by physical examination, indicating abnormal conditions.

Sims. An American gynecologist.
> **Sims's position,** the semi-prone, on the left side, with the right knee and thigh drawn upward and the patient resting forward on her chest. (See Fig. 46.)

Sims's speculum, for vaginal examination.

Sinus. A hollow cavity. 1. Certain spaces in cancellous bone, especially in the skull. (See Anatomy). 2. Large venous spaces in the cerebral circulation, also other regions. (See Anatomy.) 3. (See p. 19.) A tract leading from a suppurating cavity to the surface.

Sitz bath. A hip-bath. (See special works.)

Skin. (See Anatomy and p. 5.)
> **Skin-grafting.** The use of flaps or bits of skin to cover a granulating wound, or an area where the skin has been destroyed (burns) or removed (extensive operation of cancer).

Skiagraphy. The use of the Röntgen or X-rays for making fluoroscopic examination of deep structures, or for taking photographic plates.

Slide. Thin plate of glass to mount preparations for microscopic study.

Slough. A mass of dead tissue, the result of necrosis or gangrene.

Smear. A thin layer of blood, secretion, or discharge prepared on a slide for microscopic study.

Sound. 1. A characteristic noise produced by some body function (example: the closure of the valves of the heart), and heard through the wall of the body by means of a special instrument, *stethoscope*. 2. An instrument or probe used to explore narrow passages or cavities of the body to detect foreign bodies, constrictions, or to dilate the latter.

Spasm. A sudden and more or less involuntary muscular contraction.

Spastic. Pertaining to or resembling a spasm.

Specific. Having a single definite cause or action. *e.g.*, typhoid; also commonly applied to syphilitic infection. A drug which is accepted as a definite cure for certain conditions.

Speculum. An instrument to open or dilate the orifice of a canal or body cavity, vagina, or rectum for visual examination and treatment.

Spermatic cord. (See Anatomy.) The cord-like collection of vessels, nerves supplying the testicle, including the *vas deferens*, or duct which transmits the semen.

Sphincter. A circular muscle surrounding and closing an orifice: anus.

Spinal. Referring to the vertebral column.

　　S. cord, that portion of the central nervous system contained in the vertebral column.

Spindle cell. A type of embryonic connective-tissue cell found in certain sarcomata.

Spine. A sharp bony process. Also refers to the spinal column.

Spirilum. (See Bacteriology.) A type of bacteria.

Spirochæta. A genus of micro-organism. *Spirochœta pallida,* the specific causal organism of syphilis.

Splanchnic. Pertaining to the viscera.

Splenic. Pertaining to or associated with the spleen.

Splint. A rigid support or dressing to immobilize a part. Composed of wood, metal, or plaster of paris.

Sponge. A pad of sterilized absorbent gauze used in surgical operations.

Sporadic. Refers to occasional or scattered cases of an infectious disease.

Spore. (See Bacteriology and p. 2.) A form of bacteria which is temporarily inactive, and unusually resistant to destructive agents.

Sprain. A wounding or tearing of ligaments or tendons.

Squamous. (See Histology.) Scale-like; a type of epithelium.

Stain. Pigment used to color preparations for microscopic study.

Staphylococcus. (See Bacteriology and p. 31.) A variety of bacteria.

Stasis. Delay or blocking of the passage of contents in a canal, intestine.

Stenosis. A pathological narrowing of a canal or orifice.

Sterile. (See p. 3.) Not capable of reproducing; also, free of bacteria.

Stertorous. A type of breathing characterized by snoring, due to unusual relaxation of the voluntary muscles of the tongue and throat. (See Deep Narcosis and Coma.)

Stethoscope. An instrument to transmit and intensify the sounds produced in the body, used in physical examination.

Sthenic. Strong, active.

Stimulate. To excite or cause body activity.

Stitch abscess. (See p. 6.) An abscess which forms about a suture which penetrates the skin.

Stoma. Mouth.

Stomatitis. An inflammation or ulceration about the mouth.

Stool. Evacuation of the bowels.

Strangulated, "choked." So compressed that the blood-supply is cut off or interfered with.

Streptococcus. (See Bacteriology and p. 31.) A variety of bacteria.

Stroma. The supporting framework of a glandular structure.

Stropanthin. (See Pharmacology.) An alkaloid used hypodermically as a cardiac and circulatory stimulant, gr. 1/300 to 1/200.

Strychnine. (See Pharmacology.) An alkaloid used hypodermically as a stimulant. Dose gr. 1/60 to 1/30.

Stupes. Hot moist pads, applied to the abdomen to stimulate the passage of flatus or to relieve pain.

Stupor. A condition of partial unconsciousness.

Sub-. A prefix denoting under or below. Example: *subarachnoid,* etc.

Subluxation. A dislocation in which the displaced bone has been reduced spontaneously, but has injured the joint capsule.

Subnormal. Below the normal standard.

Supination. The position of the forearm with the palm of the hand down.

Suppository. A solid medicated substance, gelatin or cocoa-butter, to be introduced into the rectum or vagina, and absorbed.

Suppuration. (See p. 10.) The formation of pus.

Supra-. A prefix denoting above.
  Suprarenal body or **gland,** (see Anatomy), a glandular structure having an important internal secretion.

Suprarenalin, also ADRENALIN.

Surgical. Referring to pathological conditions which are treated by mechanical or instrumental means as opposed to medical, those treated by hygiene, diet, or medicines.

Suture. 1. Anatomical, the line of fusion of the bones of the skull. 2. A stitch or series of stitches used to approximate the edges of a wound, or the material used for this purpose.

Symptom. A subjective change in the condition of a patient as a result of disease, *e.g.*, pain, vomiting, etc.

Syncope. A sudden faintness or loss of consciousness.

Syndrome. A characteristic group of symptoms.

Synovia. The viscous secretion of the *synovial membrane* of a joint-cavity.

Synovitis. Inflammation of a synovial membrane.

Syphilis. (See p. 37.) A specific infection, usually venereal.

Syringe. An apparatus for injecting fluid. *Aspirating s.*, one used to withdraw fluid from a cavity.

Systemic. Pertaining to the entire system or organism.

T

Tampon. A packing or compress of gauze or cotton.

Tapping, also PARACENTESIS.

Tarsal. Pertaining to the tarsal bones of the wrist.

Temperature. The degree of heat of the body. Not a fever.

Tendon. The fibrous portion of a muscle, which is attached to bone.

Tenesmus. Contraction of involuntary muscle associated with pain; painful micturition or defecation.

Terminal circulation. That having no anastomoses or co-lateral circulation, representing the sole blood-supply to a part. (See p. 93.)

Tertiary. Usually refers to the third stage of syphilis.

Testicle. (See Anatomy.) The special sex-organ of the male.

Tetanus. (See p. 34.) An infectious process introduced into wounds and characterized by tonic contractions of voluntary muscles.

Tetany. A condition characterized by spastic contractions of the voluntary muscles.

Theca. (See Anatomy.) A tendon sheath.

Therapeutics. Therapy, any form of treatment used in the care of disease.

Thigh. The lower limb from the pelvis to the knee.

Thrombosis. (See p. 95.) The coagulation of blood in a vessel, usually a vein.

Thymus. (See Anatomy and p. 154.) A glandular structure located in the thorax, above the heart and in front of the trachea.

Thyroid. (See p. 143.) A ductless gland situated in the neck.

Thyro-glossal duct. (See p. 143.) The remnant of an embryonic structure extending from the thyroid gland to the base of the tongue.

Tibial. Referring to the tibia, the larger bone of the leg.

Tincture. (See Pharmacology.) A preparation of a medicinal substance in an alcoholic solution.

Tissue. (See Histology.) A collection of similar cells having a common function.

Tone. The normal physiological condition of the body.

Tongue. (See Anatomy and p. 136.)

Tongue depressor. A metal or wooden spatula to compress the tongue and expose the throat for examination.

    T. forceps, a special instrument to grasp the tongue without tearing, to draw it forward during deep narcosis.

    Tongue-tied (see p. 136), characterized by the presence of a short frenum which limits the movement of the tip of the tongue.

Tonic. Relating to the normal tone of the tissues; also, a medicine supposed to aid in restoring normal tone to the body functions.

Tonsillectomy. The surgical removal of the *tonsils*. (See p. 138.)

Torsion. The twisting of a pedicle in such a manner as to cut off the blood-vessels.

Tourniquet. (See p. 52.) A bandage, usually elastic, used to constrict and surround a part and control hemorrhage.

Toxæmia. (See p. 13.) A general condition due to the absorption into the body of poisonous substances: *toxines* from a local necrotic or inflammatory process.

Tracheotomy. (See p. 147.) The operation of opening the trachea through an external surgical wound in the neck.

Tract. A definite group of nerve-fibres in the spinal cord. Also, a group of organs having a common or allied function: urinary, etc.

Transfusion. (See under *Blood*.)

Transmission. The transfer of a disease.

Transplant. Grafting, the insertion of a part of tissue or organ into the same or a different individual to supply a deficiency.

Trauma. Injury.

Tremor. A trembling or shaking of a part.

Trephine. An instrument for making a circular opening in the skull.

Trifacial nerve. (See Anatomy and p. 127.) The fifth cranial nerve sensory to the face, so called from its three branches.

Trional. (See Pharmacology.) A hypnotic drug; dose gr. v to x.

Trocar. A sharp hollow needle, for perforating the wall of a cavity and removing fluid.

Trochanter. (See Anatomy.) A bony prominence at the upper end of the femur.

Truss. (See p. 163.) An apparatus used to cover a hernial opening and prevent the protrusion of the contents of the sac.

Tube. Any hollow cylindrical structure. Anatomical, fallopian tubes, eustachian tube, etc.

    Pus tubes, chronic inflammation of the oviducts.

    Drainage tubes, composed of glass or rubber.

Tubercle. A small nodule; pathologically, a mass composed of connective tissue and giant cells, caused by the tubercle bacillus and characteristic of tuberculosis.

Tuberculin. An extract prepared from special cultures of the B. tubercle, used in the diagnosis and treatment of tuberculosis.

Tumor. (See p. 40.) A swelling, usually limited to new-growths.

Turbinectomy. The removal of the *turbinate* bones projecting into the nasal passages.

Turpentine. (See Pharmacology.) A volatile hydrocarbon, derived from certain pines, used externally in emulsion as a liniment and counter-irritant, also in enema to stimulate intestinal peristalsis and expulsion of flatus.

Tympanites. Distention of the abdomen caused by the accumulation of gas in the intestine.

Tympanitic. Resonant on percussion; containing air.

Typhoid. (See Medicine and p. 33.) A specific infectious fever caused by the typhoid bacillus.

U

Ulcer. (See p. 21.) An inflammatory process involving one of the surfaces of the body or the lining of a cavity, characterized by a superficial infection and loss of tissue.

Ulnar. Pertaining to the ulna and the inner, little-finger side of the forearm.

Umbilicus. The navel, the remains of the fetal attachment of the *umbilical* cord, containing the blood-vessels important in the fetal circulation. (See Physiology and Embryology.)

Urachus. (See Anatomy and Embryology.) A fold of peritoneum extending from the fundus of the bladder to the umbilicus, representing the remains of an important embryological communication with the bladder.

Urea. (See Physiology.) One of the chief nitrogenous compounds of the urine.

Ureter. (See Anatomy and p. 214.) The duct extending from the kidney pelvis to the bladder.

Urethra. (See Anatomy and p. 219.) The canal extending from the bladder to the surface of the body at the *urinary meatus*.

Uric acid and **Urates.** Important substances derived from the body metabolism and excreted in the urine, normally in solution.

Urinary. Pertaining to the urine, also to the organs concerned in the secretion and elimination of the urine.

Urogenital. (See under *Genito-urinary*.)

Urotropin. (See Pharmacology.) A proprietary preparation of hexamethylenamine.

Uterine. Pertaining to the *uterus*. (See Anatomy.)

V

Vaccine. (See special works and p. 16.) A substance representing the inactive agent of an infectious process, killed bacteria, injected to confer immunity or to increase the resistance to the specific infection.

Vagina. (See Anatomy.) The canal extending from the cervix of the uterus to the external genital opening, the *vulva*.

Vagus. (See Anatomy and p. 113.) The tenth cranial nerve, or pneumogastric.

Valve. A membranous fold projecting into the lumen of a canal, and permitting the movement of contents in only one direction.

Varicocele. A mass of dilated and tortuous blood-vessels, veins.

Varicose. (See p. 96.) Dilated and tortuous vessels, usually veins.

Vas. A vessel or duct.
   V. deferens, the excretory duct from the testicle.

Vaso-. Pertaining to the blood-vessels and vascular system.
   Vasomotor, the nerve-centre controlling dilatation and constriction of the arteries, and influencing blood-pressure.

Venereal. Pertaining to or due to sexual intercourse.

Venesection. Opening a vein; bleeding.

Ventral. Anterior or front part of a body or structure.

Ventricle. (See Anatomy.) A small cavity.

Vermiform. A worm-like structure.
   V. appendix (see Anatomy and p. 192.)

Veronal. (See Pharmacology.) A hypnotic drug; dose gr. v to x.

Vertebral. Pertaining to the vertebræ and spinal column.

Vesicle. A sac containing fluids; *vesical*, pertaining to such a sac. Example: the bladder.

Viscus. An organ.

Visceral. Pertaining or relating to an organ.

Voluntary. Under the direct control of the will.

Volvulus. (See p. 180.) A twisting of a part of the intestine in such a manner as to occlude its lumen and cut off the blood-supply.

Vomit. To expel material from the stomach by way of the mouth.

Vulva. (See Anatomy.) The external genital opening in the female.

W

Wart. An outgrowth from the epithelium of the skin.

Wassermann test. (See special works.) A specific blood-test used in the diagnosis of syphilis.

Wen. (See p. 117.) A sebaceous cyst in the scalp.

Wound. (See p. 49.) A solution of continuity of a tissue or structure, usually involving the skin.

Wrist. The junction of the hand and forearm.

   Wrist-drop, a characteristic deformity due to paralysis of the extensor muscles of the hand, from injury or disease of the *radial* or *musculospiral* nerve.

X

X-ray. The Röntgen ray. (See special works.)

Xiphoid. The lower end of the sternum. (See Anatomy.)

Y

Yeast. A species of vegetable parasite, non-pathogenic.

Yucca-wood. Material used to make splints.

Z

Zinc-oxide. (See Pharmacology.) An amorphous, antiseptic powder, used also in ointment and in the composition of adhesive plaster.

Zygoma. (See Anatomy.) The bony arch, above the cheek.

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